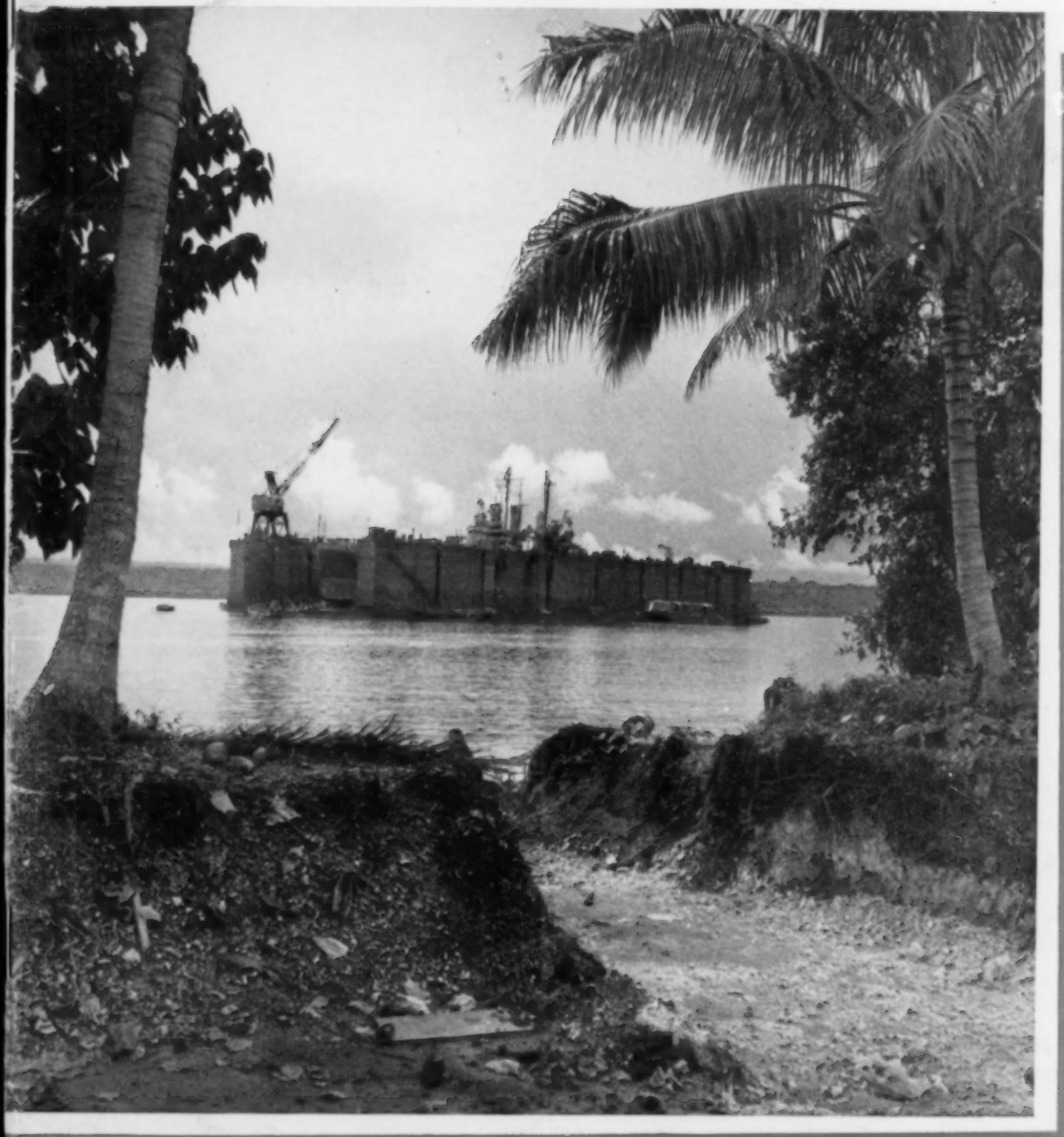
Compressed Air Magazine

SEPTEMBER 1945

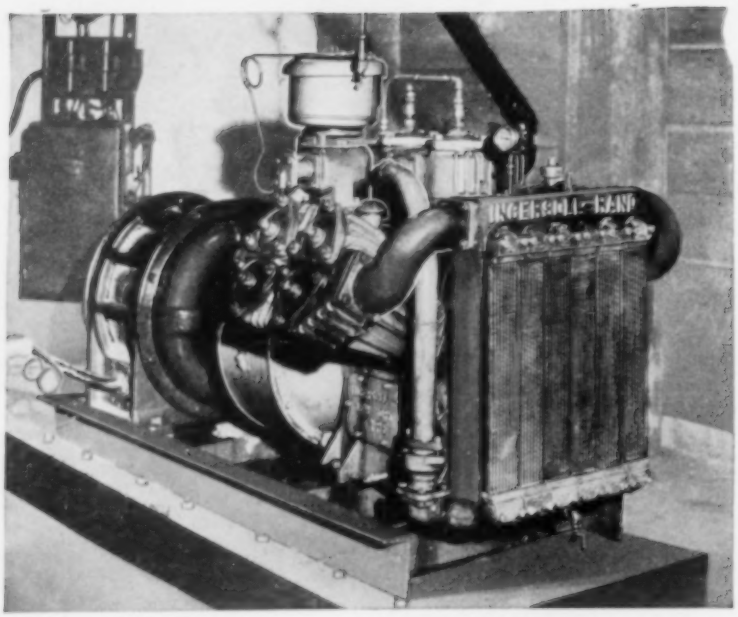


FIELD HOSPITAL
FOR NAVY SHIPS

One of our sectional dry docks servicing a damaged war vessel in the Pacific

VOLUME 50 • NUMBER 9 NEW YORK • LONDON

KEEP COMPRESSOR VALVES CLEAN AND EFFICIENT



...by using the outstanding compressor oils that...

- ★ Keep compressors free from hard carbon deposits
- ★ Prevent ring-sticking
- ★ Assure wide-opening, tight-shutting valves
- ★ Keep ports open, air lines clear

USE of *Texaco Alcaid, Algol or Ursa Oils* brings you these important benefits which add up to longer service between overhauls, fewer repairs and replacements, better performance at lower cost.

Texaco Alcaid, Algol and Ursa Oils are typical examples of petroleum products improved through The Texas Company's constant research. They are made in one of the world's largest refineries from carefully selected crudes processed by modern Texaco methods to provide efficient and economical compressor operation. Their production is 100% Texaco controlled from well to finished product to assure absolute uniformity.

Texaco Lubrication Engineering Service is available through more than 2300 Texaco distributing plants in the 48 States. Get in touch with the nearest one, or write:

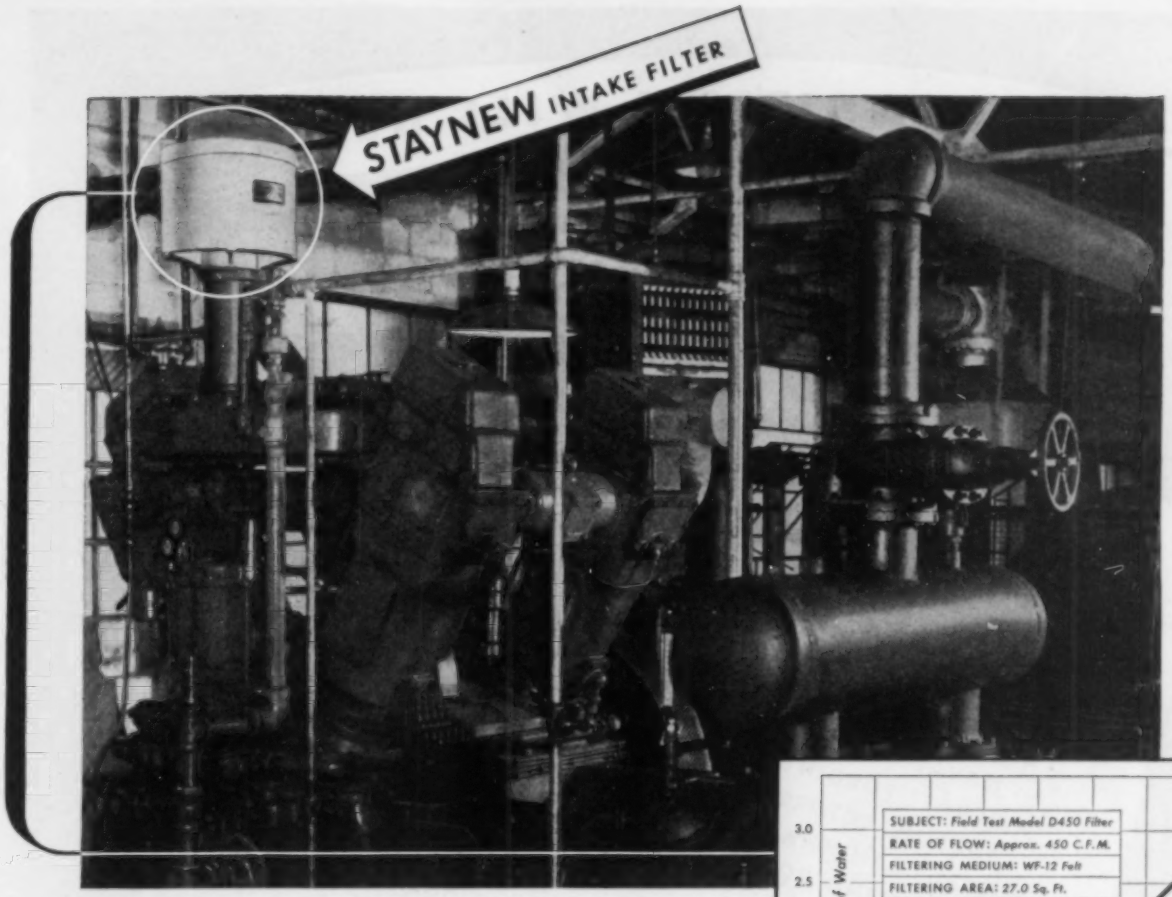
The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Lubricants

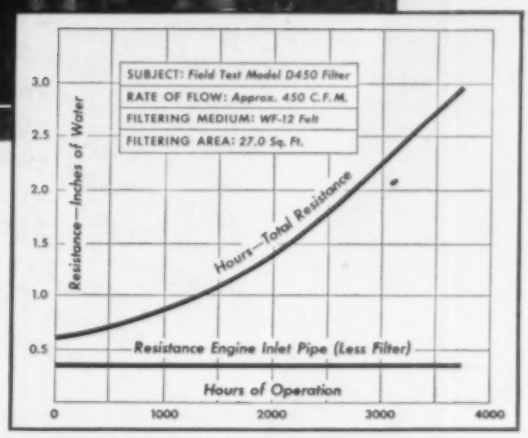
FOR ALL AIR COMPRESSORS AND TOOLS

TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON EVERY SUNDAY NIGHT—CBS



3761 HOURS CONTINUOUS OPERATION WITHOUT ATTENTION

Yet Filter Resistance Is Only 2.73 Inches of Water



This filter, installed on a Diesel-powered compressor, operates under unusually severe conditions. Intake air is heavily loaded with dust and oil; the dust due to the close proximity of a railroad siding where bulk lime, sand, and coal are handled—the oil to two additional Diesel-powered compressors operating in the same room.

Such a case history is not unusual. Reports are frequently received of Staynew Filters operating under less severe conditions for two or more years without attention—with the initially high efficiency rising as dust load increases.

Ease of cleaning as well as infrequency of cleaning is also an important feature, requiring only a few minutes with the specially designed Staynew Cleaning Nozzle.

More and more experienced operators of compressor and engine equipment specify Staynew Intake Filters—not only because of the minimum attention required, but also because these filters:

- ★ **Provide positive protection**
- ★ **Require no pre-coat or filter aid**
- ★ **Are unaffected by extremes of temperature**
- ★ **Permit use of oversize filters (air velocity not critical)**
- ★ **Are ideal for use with carbon ring compressors**

STAYNEW FILTERS

DOLLINGER CORPORATION

Silver ANNIVERSARY 1920–1945

(Formerly Staynew Filter Corporation)

7 CENTRE PK., ROCHESTER 3, N. Y.

Representatives in Principal Cities

THE TRANSITION WILL BE EASY

AT NATIONAL FORGE

WAR PRODUCTS

PERISCOPE TUBES
GUN BARRELS
GUN PARTS
BREECH BLOCKS
BREECH HOUSINGS
NAVAL SHAFTS
AIRCRAFT FORGINGS
TURBINE ROTORS
DIESEL CRANKSHAFTS
CONNECTING RODS
COMPRESSOR SHAFTS
COMPRESSOR CYLINDERS
MACHINERY FORGINGS
PIPE MOLDS
BORING BARS
INGOTS

PEACE PRODUCTS

DIESEL CRANKSHAFTS
CONNECTING RODS
COMPRESSOR SHAFTS
COMPRESSOR CYLINDERS
MACHINERY FORGINGS
PIPE MOLDS
BORING BARS
TURBINE ROTORS
COLUMNS
LATHE SPINDLES
ECCENTRIC SHAFTS
NON-MAGNETIC FORGINGS
PISTON RODS
RAM FORGINGS
TIE RODS
TRUNNIONS
RINGS
SHAFTS
INGOTS
—and many other forgings

Note that many products made for war are the same as products made for peace.

Now that the pattern of peace begins to take form, so does the pattern of peacetime production. And heavy duty steel forgings will have a basic place in that pattern—to an even greater extent than in the prewar period. So it's not too early to know who will be your forging makers, even if the design of those forgings is not yet on paper.

This, then, is the time to know National Forge. Not just because it has been making forgings for thirty years. Or because its facilities naturally have been greatly expanded during the war years. Or because it has five White Star Citations for excellence in wartime production—earned with the same men and machines that will be available for peacetime work. But very much because of the experience, the "know how" and the proved procedures it can place at your command in planning the forgings of tomorrow—today. Let this new book tell you why.

NATIONAL FORGE & ORDNANCE CO.

IRVINE, WARREN COUNTY, PENNSYLVANIA

"WE MAKE OUR OWN STEEL"

IF YOU HAVEN'T GONE THROUGH THE PLANT, BE SURE YOU GO THROUGH THIS BOOK—WRITE FOR YOUR COPY

Excellay Preformed

THE CONFIDENCE miners and operators have in TIGER BRAND Excellay Preformed Wire Rope is well placed. Actual on-the-job comparisons have proved repeatedly that this superior cable is tougher, yet easier and safer to handle than non-preformed wire rope.

U·S·S American TIGER BRAND Excellay Preformed Wire Rope is more flexible. It doesn't kink easily. Spools evenly. Crown wires lie flat and in place when broken. They do not stick out to cut hands or tear clothes of handlers.

All of these, plus TIGER BRAND's great stamina, mean less time lost because of repairs, replacements and accidents. In other words, speedier, more profitable mining.

Whatever your material handling, hauling or hoisting job, you'll find an American TIGER BRAND Wire Rope built for the purpose.

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York

COLUMBIA STEEL COMPANY
San Francisco

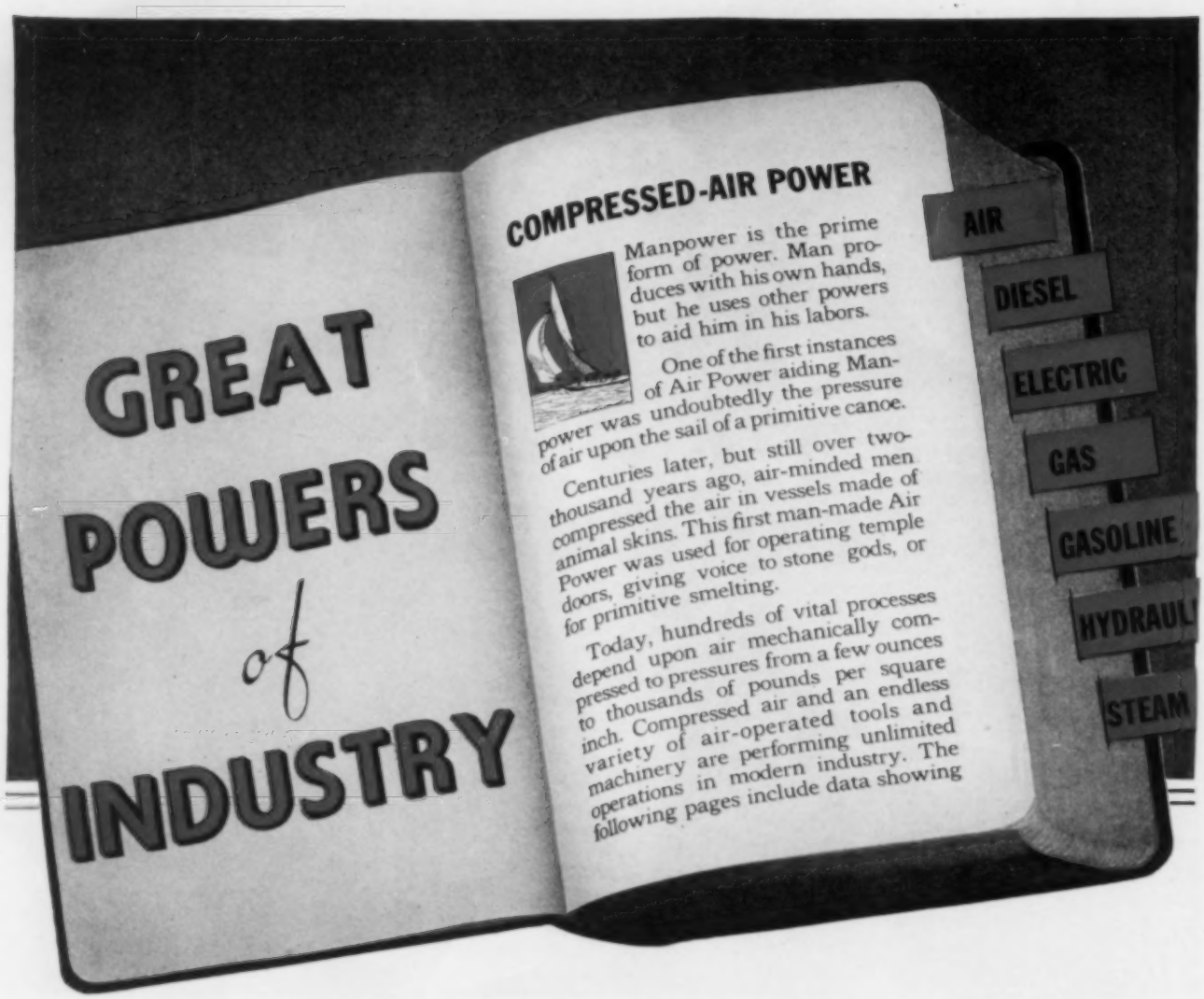
United States Steel Export Company, New York

UNITED STATES STEEL

U·S·S STEEL
UNITED STATES STEEL

U·S·S AMERICAN

TIGER BRAND *Wire Rope*


GREAT
POWERS
of
INDUSTRY
COMPRESSED-AIR POWER
Manpower is the prime form of power. Man produces with his own hands, but he uses other powers to aid him in his labors.
One of the first instances of Air Power aiding Manpower was undoubtedly the pressure of air upon the sail of a primitive canoe.
Centuries later, but still over two-thousand years ago, air-minded men compressed the air in vessels made of animal skins. This first man-made Air Power was used for operating temple doors, giving voice to stone gods, or for primitive smelting.
Today, hundreds of vital processes depend upon air mechanically compressed to pressures from a few ounces to thousands of pounds per square inch. Compressed air and an endless variety of air-operated tools and machinery are performing unlimited operations in modern industry. The following pages include data showing
AIR
DIESEL
ELECTRIC
GAS
GASOLINE
HYDRAULI
STEAM

This book is not for sale . . . as far as we know, it does not exist.

If it did, such a book would point out the types of work that can be accomplished by *several* forms of motive power used by industry . . . the problems that can be solved *better by one* than by any other . . . the things that can be done by *only one* of them . . . and the still other jobs that require *combinations* of several powers.

In the absence of such a book, we must all depend upon experienced engineers and manufacturers to advise us of the very latest practices in their particular fields.

So if you are not thoroughly familiar with *Compressed-Air Power* . . . what it is doing for others, and what it can do for you . . . get in touch with an Ingersoll-Rand Engineer. He knows Air Power and its applications.

Ingersoll-Rand

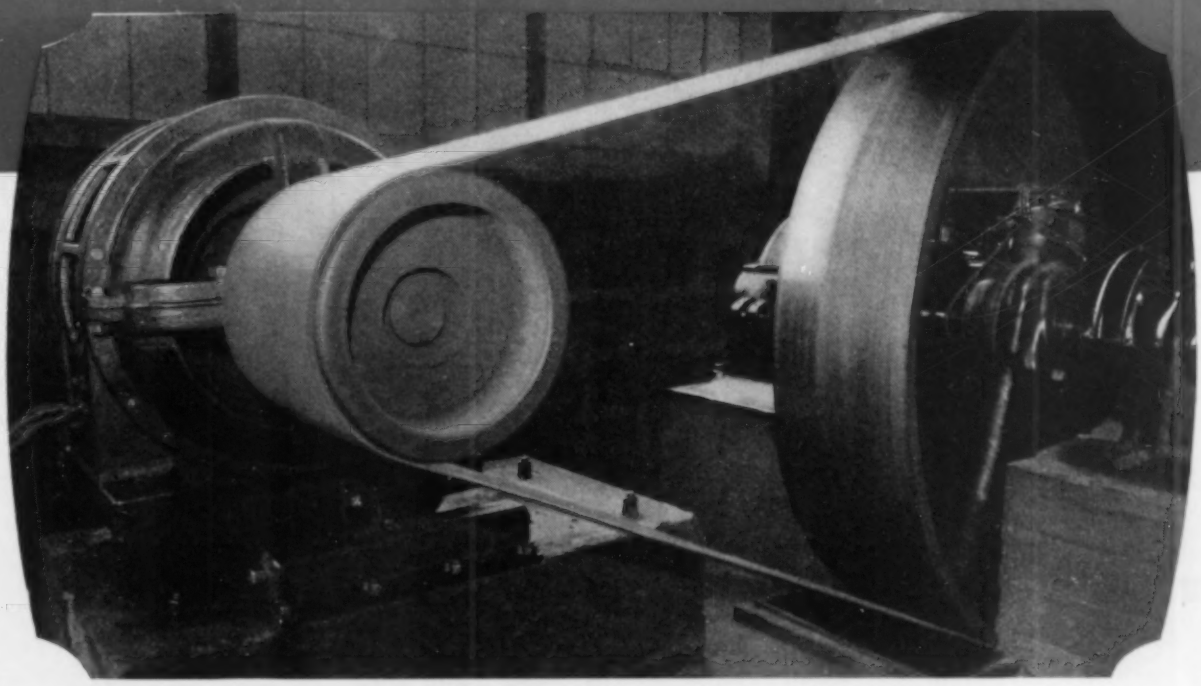
11 BROADWAY, NEW YORK 4, N. Y.

1-632

COMPRESSORS · AIR TOOLS · ROCK DRILLS · TURBO BLOWERS · CONDENSERS · CENTRIFUGAL PUMPS · OIL AND GAS ENGINES

"We Anticipate Greatly Prolonged Belt Life—"

...Writes the Chief Engineer of this Paper Mfg. Co.



Tannate-Rockwood Drive operating an Ingersoll-Rand compressor at the Hamersley Manufacturing Company, Inc., Garfield, N.J. Writes Mr. George Moreland, Chief Engineer, "The new drive seems to work very smoothly . . . we anticipate a greatly prolonged life for the belts on this job."

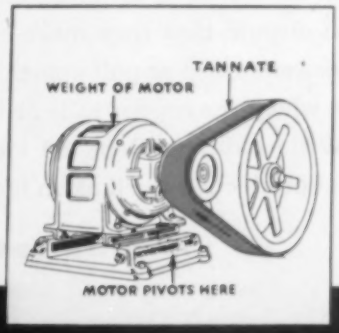
This installation replaced a short center drive with a 300-pound idler pulley which caused heavy wear on the belts used previously. 22″ Driver pulley; 96″ Driven pulley; 8′8″ Center. 150 HP motor, 695 rpm. Installed November 1944.

In paper making, as in other lines, Tannate-Rockwood Drives are proving most satisfactory, reliable and economical day in and day out.

Correct belt tension is maintained, and automatically adjusted to changing load conditions, by the weight of the motor on the pivoted base. This assures maximum power transmission efficiency . . . operation is steady, with little or no maintenance.

TANNATE Belting is preferred with this drive because TANNATE is stronger, tougher, more flexible . . . with a firm pulley grip that keeps the machine running steadily, at full capacity. TANNATE has the stamina and endurance for a long life of service.

In *your* plant, Tannate-Rockwood Compressor Drives would probably also prove efficient and economical. May we give you more information by mail or by having a Rhoads Service Engineer call?



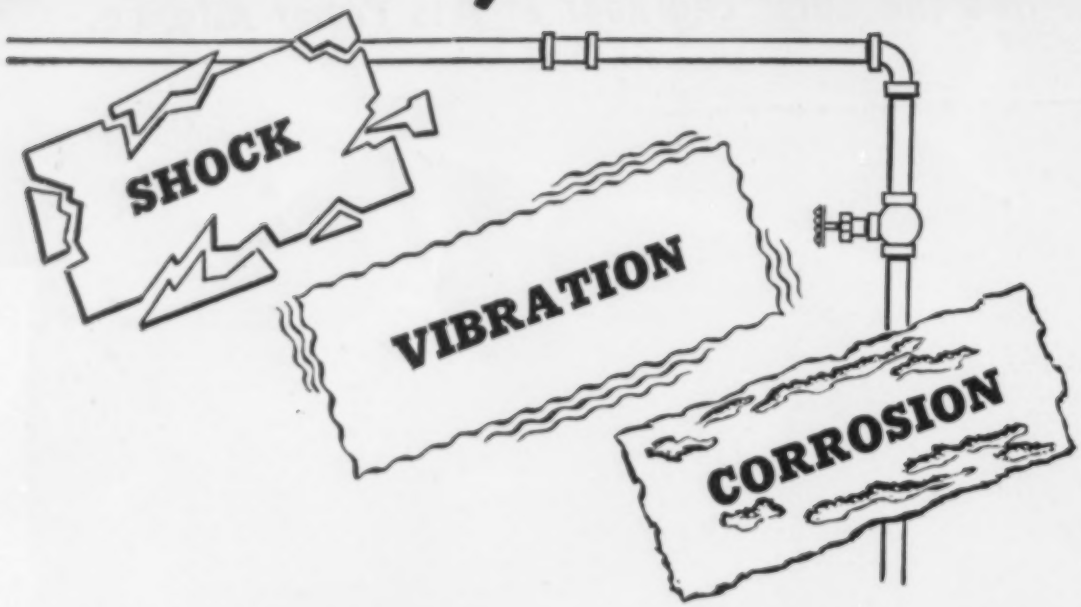
J. E. RHOADS & SONS 35 N. SIXTH ST., PHILA. 6, PA.
Established 1702 NEW YORK · CHICAGO · ATLANTA

RHOADS

Tannate-Rockwood

SHORT CENTER DRIVE

End the Triple Menace TO COPPER TUBE AND BRASS PIPE LINES



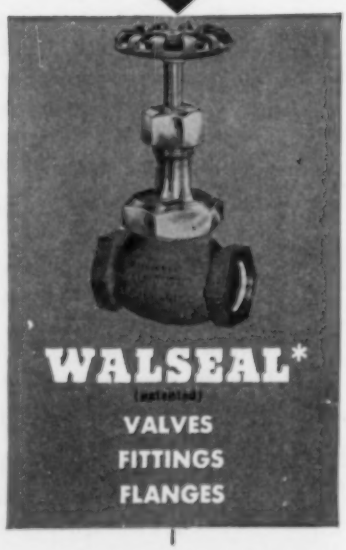
with THREADLESS SILBRAZ* JOINTS

Shock! Vibration! Corrosion! Yes, a Silbraz Joint made with Walseal* valves, fittings and flanges "has what it takes" to overcome this triple threat to copper tube (iron pipe size) and brass pipe lines—and for keeps.

Why? Because patented Walseal valves, fittings and flanges get their *extra* stamina from a ring of silver brazing alloy built right into each port . . . an alloy that when heated with an oxyacetylene torch flows out between the pipe wall and the fitting, making a joint that is stronger than the tube or pipe itself.

In thousands of installations, these Walseal products have proved beyond dispute that they make a "one piece pipe line" . . . a pipe line that does not creep or pull apart under any shock, vibration or temperature to which the copper tube or brass pipe can be safely subjected.

Write today to Dept. 84 for Catalog 42 giving complete data on Walseal products, as well as on the entire Walworth line.



Make it a "one-piece pipe line" with WALSEAL

12 AWARDS TO 4 PLANTS

WALWORTH

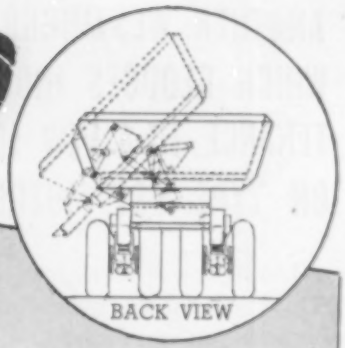
valves and fittings

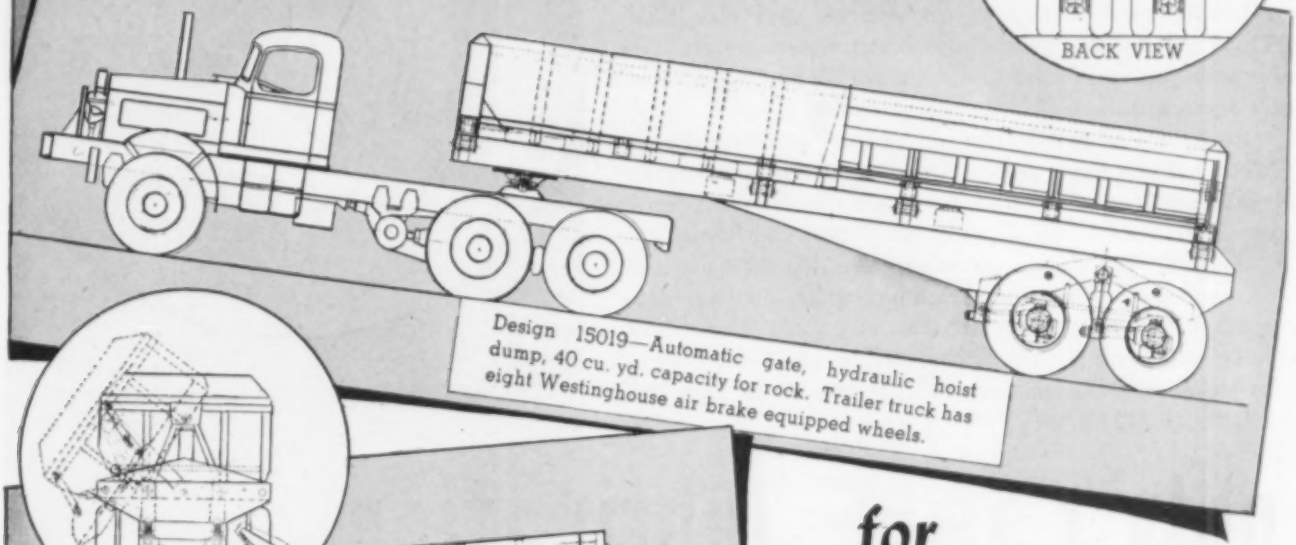
60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

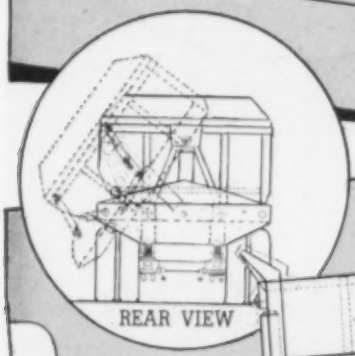
*Patented – Reg. U.S. Patent Office

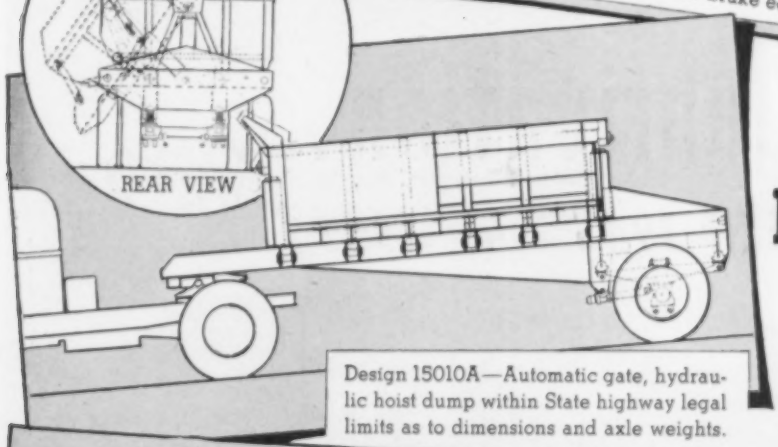
ENGINEERED



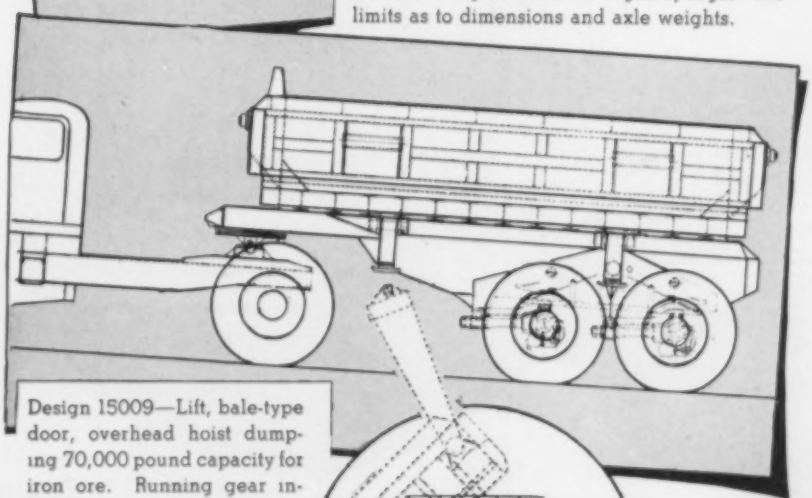


Design 15019—Automatic gate, hydraulic hoist dump, 40 cu. yd. capacity for rock. Trailer truck has eight Westinghouse air brake equipped wheels.

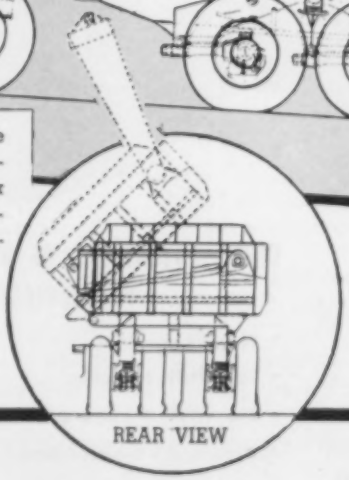




Design 15010A—Automatic gate, hydraulic hoist dump within State highway legal limits as to dimensions and axle weights.



Design 15009—Lift, bale-type door, overhead hoist dumping 70,000 pound capacity for iron ore. Running gear includes eight independent full-floating, sprung wheels.



for
BIGGER PAYLOADS

Tomorrow's production will require bigger crushers, larger shovel dippers, longer hauls with bigger payloads. EASTON engineers are planning equipment to keep pace with rapidly changing trends for moving economically all types of ore, trap rock and limestone.

Write to: Engineering Counsel, Easton Car & Construction Co., Easton, Pa.

B-1014

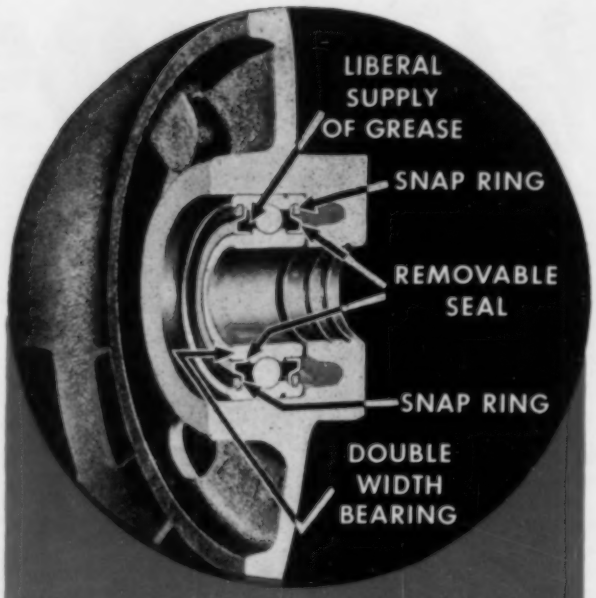
EASTON
INDUSTRIAL CARS
TRUCK BODIES · TRAILERS
ELECTRIC LIFT TRUCKS

ANOTHER WESTINGHOUSE MOTOR "FIRST" WHICH REDUCES INDUCTION MOTOR MAINTENANCE TO A NEW LOW... NOW STANDARD ON TYPE CSP MOTORS, 3 HP AND BELOW

Install now... lubricate once between 1945 and 1955! Think of what this means in terms of man-hours saved—because you can forget lubrication of Type CSP Motors for *5 years* or more after they are installed.

Prelubricated ball bearings are not new in Westinghouse Motors. They have been proved in thousands of textile motor applications—which have run continuously for 7 years and been found in perfect condition after that time.

The CSP motor is another example of the extensive and continuous Westinghouse developments which have contributed to induction motor design. For full information, call your Westinghouse office—ask for DB-3100-CSP, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-21330



only ONE lubrication...

BETWEEN 1945 AND 1955!

This "PRELUBRICATED" Label (on end bracket of all CSP motors up to frame 225) your assurance of:

- No overgreasing
- No unreplaced plugs
- No grease seepage into windings
- No "skipped" bearings
- No grease contamination
- Simplified lubrication schedules

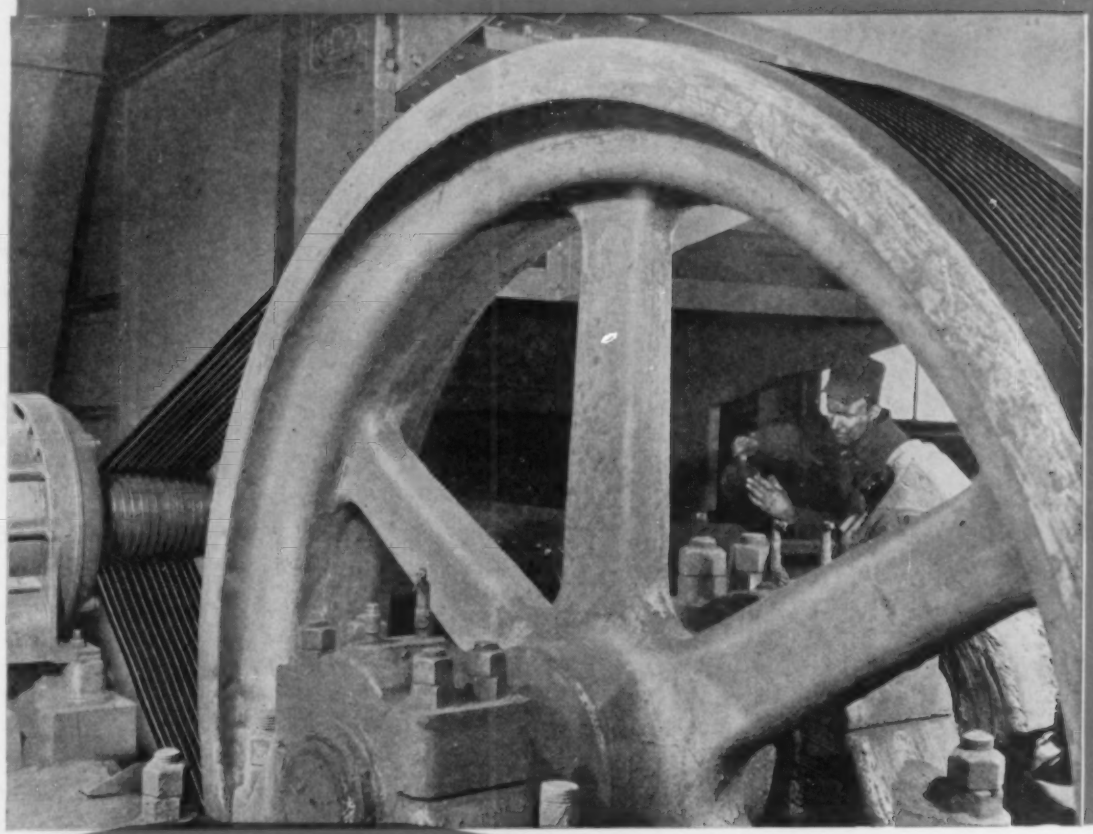
OTHER ADVANTAGES OF WESTINGHOUSE TYPE CSP PRELUBRICATED MOTORS

- Longer grease life
- TUFFERNELL Insulation
- *Die-cast Rotor* with oversize fan
- *Dynamically Balanced Rotor*
- *Liberal Through-Ventilation*—air enters front and leaves at drive end of motor

Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

TYPE CSP MOTORS

SCREENING COAL ...AT 400 TONS AN HOUR!



•ABSORBING SHOCKS—
•UNMINDFUL OF DUST—
•120 HOURS WITHOUT REST!

Twelve Dayton V-Belts driving this gigantic pulley to keep it spinning 24 hours a day, five days a week—120 hours at a stretch—operate the huge coal screen which handles 400 tons of coal an hour. This power drive is subjected to an intermittent, shock-type load that puts the Dayton V-Belts to a most severe test.

But tough as the job is, it's all in a day's work for Dayton V-Belts. They are built to absorb shock-type loads, heavy starting and stopping loads; built to withstand heat, dirt, humidity and other difficult operating conditions. They can do these things because they are designed from research experience covering 40 years of manufacturing natural and synthetic rubber products. No wonder Dayton V-Belts can stand the gaff of the most gruelling power transmission jobs.

Your Dayton V-Belt Distributor will gladly show you how you can make these Dayton V-Belt advantages pay dividends for you—how Daytons can save you space, eliminate noise, and bring power transmission maintenance costs to a minimum. It will take only a minute to call him. Do it today!

THE DAYTON RUBBER MANUFACTURING COMPANY
DAYTON 1 • OHIO

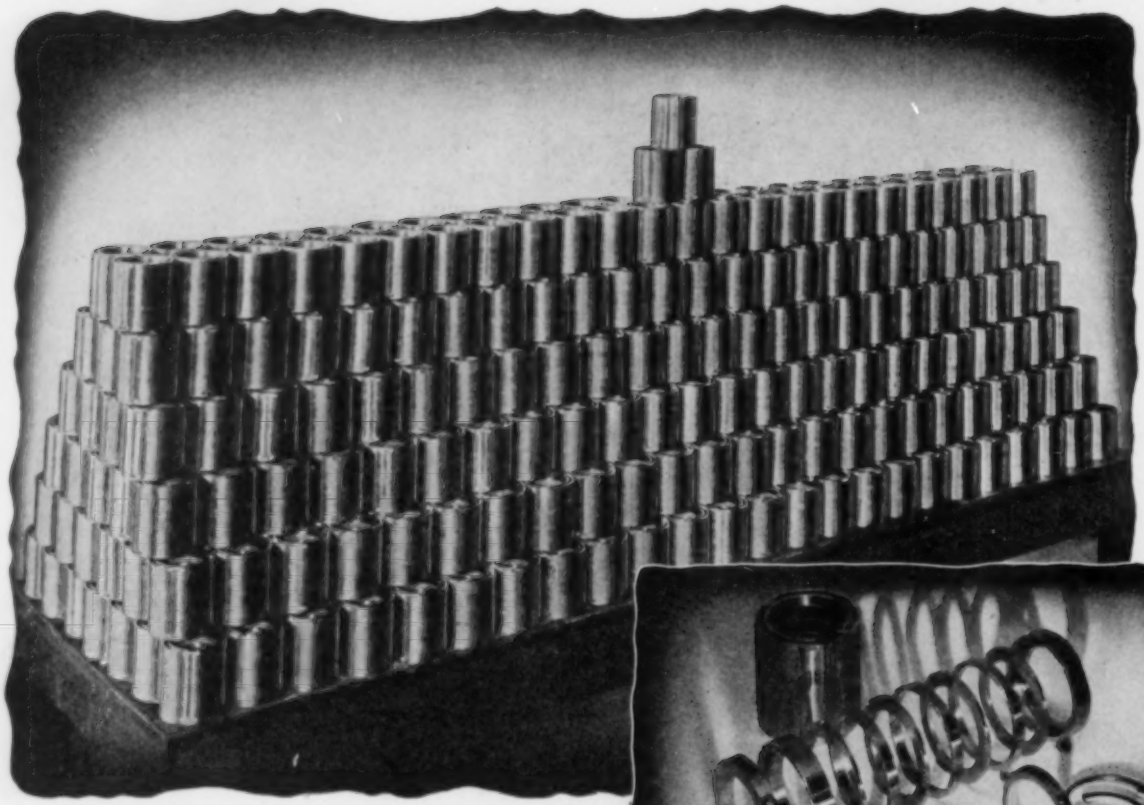
V-Belts by

Dayton Rubber

REG. TRADE MARK THE DAYTON RUBBER MFG. CO.

THE MARK OF TECHNICAL EXCELLENCE IN SYNTHETIC RUBBER

THE WORLD'S LARGEST MANUFACTURER OF V-BELTS



VITAL AS ARTILLERY SHELLS!

COOK'S GRAPHITIC IRON PISTON RINGS too, are playing a big part in the war effort on land and sea.

PACKINGS empower ships to move and industry to produce the implements of war . . . For without packings no steam engine, no Diesel, no gas engine and no compressor could function . . . From this fact it can be understood that wartime's demands for packings have been vast and urgent . . . In meeting them, COOK'S Metallic Packings have played a major role . . . Month after month they have poured out in a steady stream to equipment manufacturers, to shipyards, chemical plants, steel mills, oil and gas fields and industry in general — standard COOK'S Packings by the thousands — and many special designs, engineered to meet new service conditions . . . One such special service packing is illustrated, with a typical month's production . . . The satisfaction of contributing so materially to the war effort has been marred by one thing only — the impossibility at times of promptly filling the needs of some of our old and valued customers . . . For their understanding patience and patriotic spirit of cooperation, we sincerely thank these customers — and assure them that, while continuing the war job still to be done, we are doing everything possible to restore the prompt shipment on all orders and immediate shipment in emergencies that has always distinguished COOK service.

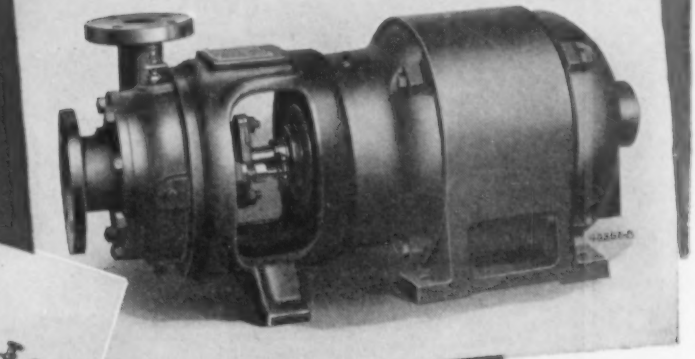
Sealing Pressures Since 1888

C. LEE COOK MANUFACTURING CO. INCORPORATED

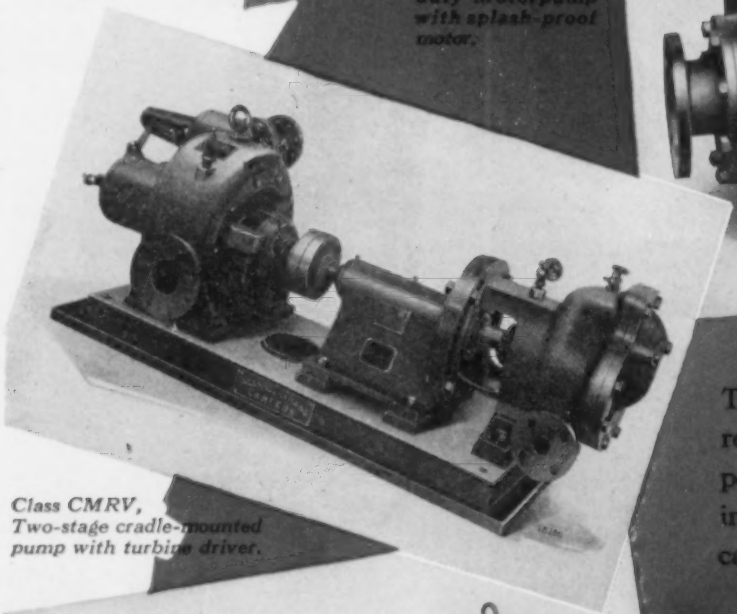
LOUISVILLE, KY.

BALTIMORE • BOSTON • CHICAGO • CLEVELAND • HOUSTON • LOS ANGELES • MOBILE • NEW ORLEANS • NEW YORK • SAN FRANCISCO • TULSA

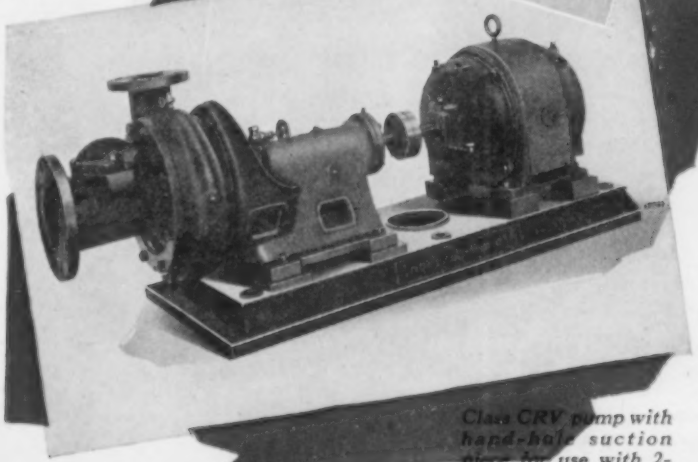
So you NEED A *Special* PUMP



Class RV, heavy-duty Motorpump with splash-proof motor.



Class CMRV, Two-stage cradle-mounted pump with turbine driver.



Class CRV pump with hand-hole suction piece for use with 2-vane open impellers.

That's right, there are many jobs that require pumps with special features—perhaps an open impeller, a smothering-type stuffing-box gland, shrouded casing rings, a portable mounting, etc.

Do you know that you can often have just the special features you need on a pump from the Motorpump line...have these features without costly alterations, without extending delivery and without impairing normal performance of the unit.

Motorpumps are built to take a wide selection of drivers. They are available in iron, steel, bronze, or bronze-fitted construction.

Let an Ingersoll-Rand engineer tell you more about these pumps. He will be glad to give you a copy of Bulletin 7093. This contains complete descriptions, illustrates many of the modifications, gives selection tables, dimensions, weights and other essential details.

THE CAMERON

MOTORPUMP

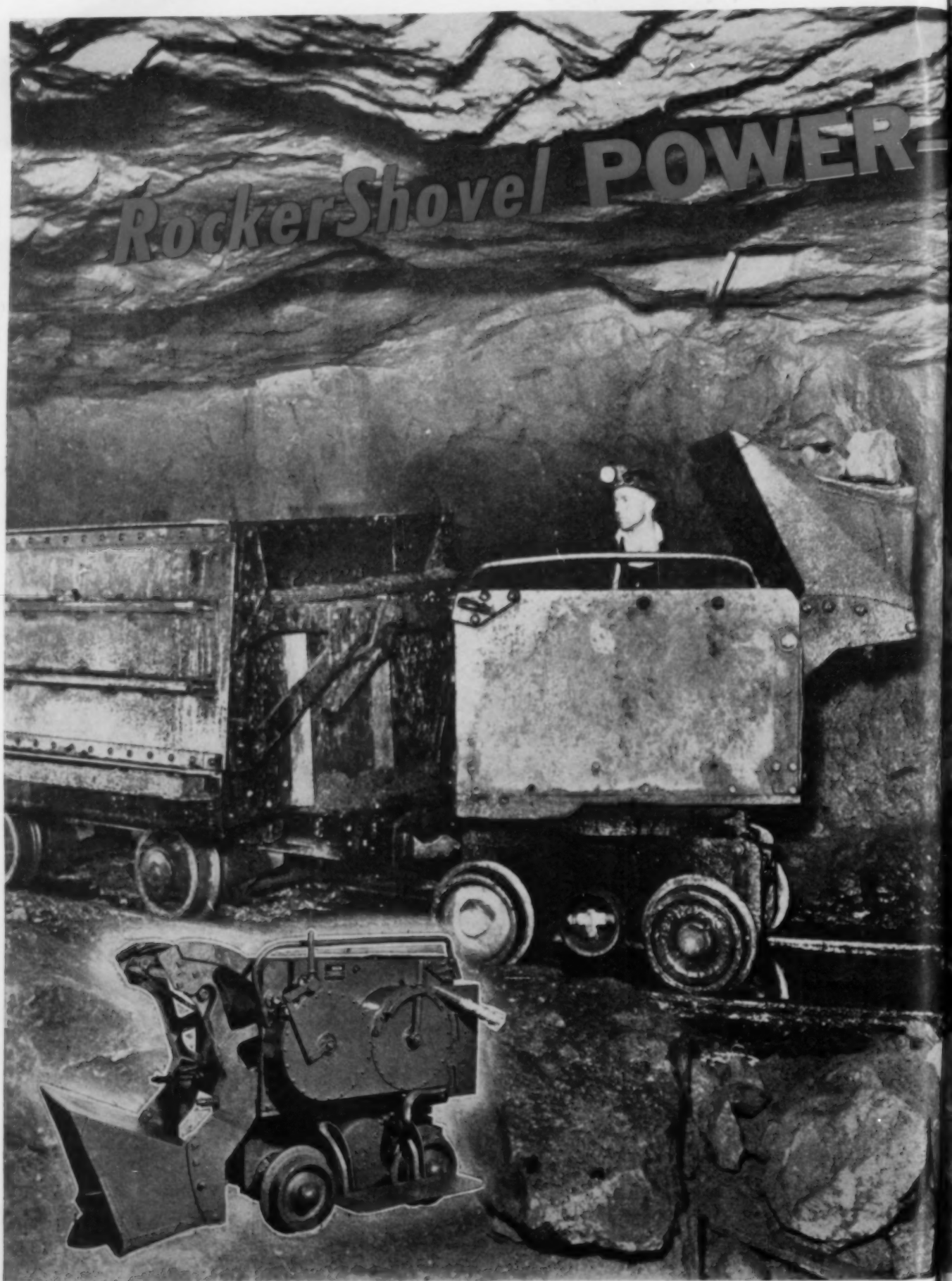
AN INGERSOLL-RAND PRODUCT

COMPRESSORS · AIR TOOLS · ROCK DRILLS
TURBO BLOWERS · CONDENSERS
CENTRIFUGAL PUMPS
OIL AND GAS ENGINES

Ingersoll-Rand

CAMERON PUMP DIVISION
11 BROADWAY, NEW YORK 4, N. Y.

9-709


RockerShovel POWER-

Air or Electric

The motive power used to operate the Eimco RockerShovel may be air or electricity. In either case, motors and controls have been engineered and designed to deliver a maximum of horsepower in a minimum of space.

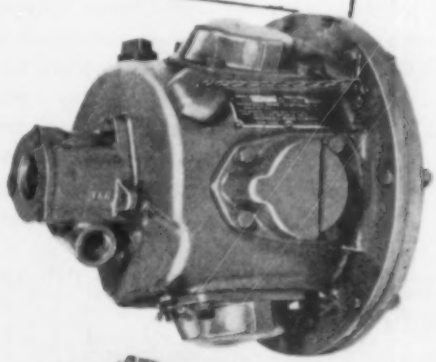
Air-driven RockerShovels were the first underground loaders to employ sturdy piston-type Ingersoll-Rand pneumatic motors which gave operators a power-flex to meet every digging and loading demand. Responsive, quick acting controls assure easy handling.

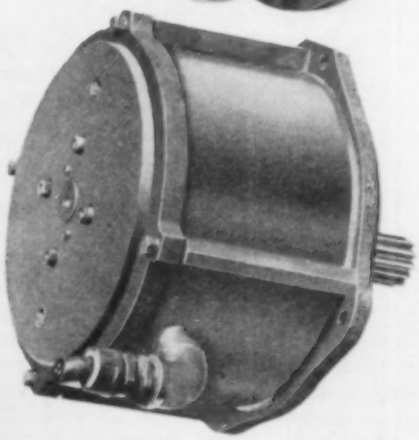
Eimco electrical engineers were detemined to give the RockerShovel electric motors and controls that were equally as simple and efficient.

The Model 21 and the Model 40 can now be furnished with electric drives in either AC or DC current. The inset illustration shows the control side of an AC220 volt electric driven Model 21 RockerShovel. Safe, compact, easy to handle, electrically driven RockerShovels lead the way in progressive engineering and timely adaptation of electric energy as applied to underground loading.

Shown at right is a RockerShovel air motor and electric motor used on the Model 21.

RockerShovels are made in three sizes for underground service; the Model 12B loads at the rate of 1 ton per minute, the Model 21 loads at the rate of 2 tons per minute, and the Model 40 loads at the rate of 3 to 5 tons per minute.





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BULLETIN!

How to Take a

Reconversion Inventory

of Your V-Belt Drives

☛ As manufacturing equipment becomes more widely available, and as you reconvert your production toward a peacetime basis, you may be faced with an unprecedented problem of inventory-taking.

☛ You may have to determine—more quickly than such a job has ever been done before—the EXACT CONDITION of every piece of existing equipment that you propose to use in peacetime production.

☛ Here are suggestions to speed your inventory of V-belt drives. The standards stated here will let you determine which of your *belt sets:* (1) are okay as is; (2) will shortly require replacement; (3) need immediate replacement. You should be able to place *sheaves* in the same categories, or in a fourth: (4) are obsolete . . . a common failing of sheaves, now that "Magic-Grip" and Vari-Pitch Sheaves are becoming more readily available. Or you may decide that entire *drives* belong in a fifth classification: (5) need re-engineering . . . either to correct misapplications forced by wartime shortages, or to take advantage of new developments such as Allis-Chalmers' Variable Speed Drives, with either Stationary or Motion Control.

1 START YOUR INVENTORY WITH THE RECORDS

Your records will reveal much that will be of value to you in appraising your present multiple V-belt drive equipment and in establishing its place in reconverted production.

Purchase records should show which drives have required new belts too frequently. While there's no overall rule to tell you how long a belt should last, it's safe to assume that *whenever you spot a drive* whose belts wear out *much* more rapidly than all the others, *you've found a place* where a change will save you money.

Maintenance records, and *machine operating records* will reveal useful facts. Is a machine often down while belts are replaced? While sheaves are changed? Then there's room for improvement. Check trouble spots *first*. You can spot these trouble spots if you'll *start with the records*.

2 THEN CHECK DRIVE ENGINEERING

V-belt wear will be excessive — too costly for competitive peace-time operation — unless the drive is tailored to its particular power transmission job in the following respects:

Diameters—Depending on the thickness of its section, every V-belt has an "easy arc". Bend it more sharply (around a sheave of too small diameter) and the internal friction of excess flexing will cook the life out in far too short a time. In general, minimum sheave diameters for belts of given section are as follows: A—3.0″; B—5.4″; C—9.0″; D—13.0″; E—21.6″.

Centers—The shorter the centers in a drive, the fewer feet of belt that can stretch—the lower the potential stretch to threaten slippage and crack-the-whip action. Thus proper engineering aims at short centers. (Short centers have the further advantage of saving valuable floor space . . . an important consideration in many factories.) In every re-application of V-belt drives for reconverted production, remember . . . *keep centers as short as possible.*

Number and size of belts — Each V-belt is rated for horsepower; simple mathematics will tell you how many of what size you'll need for a given job. When reconverting, it's wise to *check this again* . . . the war has produced many undesirable makeshifts. Remember, though, that number and size don't tell the whole story—*speed counts too.*

Belt speed—Just as a truck's motor can pull a heavier load by traveling faster, so a set of V-belts can pull a heavier load by traveling faster. In a truck, it's a case of using a "lower" gear. In a V-belt drive, it's the same . . . using larger sheaves which have a higher rate of rim travel, thus producing higher belt speed. See the V-belt manufacturer's catalog for limits of speed recommended for any given belt.

Contact arcs—All horsepower ratings for V-belts are based on a 180 degree arc of contact with sheaves. However, this factor varies from one drive to the next—depending on its ratio and centers—and must be carefully considered in re-engineering any drive.

Tension—Each drive should be equipped with an effective tension adjustment. Belts that are too loose will slip, rub on the groove walls, heat up, and have the life cooked out of them. And when the wave curve in a loose belt whips it *tauter* across the tension

side of the drive—that belt grabs at the load, may snap. So—in checking V-belt drives for reconverted production, it's important to see to it that each set of belts has proper tension. The easiest and quickest rule-of-thumb test for proper tension is this: "A slack V-belt feels dead when you thump it with your hand; a properly taut V-belt has an alive springiness."

Alignment—Unless the shafts of the driving and driven sheaves are *parallel*, it's impossible to put *all* belts in the set at proper tension . . . and all belts run at an angle, rubbing on the groove walls, heating themselves for an early death. In reconverting for a competitive production, check parallelism of shafts . . . and check too to see that *sheave grooves* are *in line*. Out-of-line sheaves also subject belts to needless rubbing on the groove walls.

If any of your V-belt drives is notably weak in any of the above seven points, consider re-enginering the drive.

3 THEN INSPECT V-BELTS

Your inventory of working V-belts will reveal far more than just their condition; it will also show what should be done to correct existing conditions that promote V-belt wear—an important consideration in cost-conscious, competitive production. Check every belt in every set for the following tell-tale signs; note condition of belt, cause, and recommend cure.

Checking these points is especially important if you're planning a *continuous* operation where belt breakage would be fatal. You can spot about-to-break belts by looking for:

SCUFFING — *Cause*: Bolts protruding inside the guard may do this. Such scuffing can exert enough "braking" to cause sudden snap and break belt.

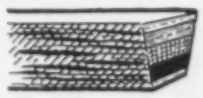
Cure: When placing guards or steelwork near drives, anticipate some sag . . . leave enough clearance.

SLIP BURN — *Cause*: Belt too loose to pull its load. Belt stands still, rubbing on spinning driving sheave, heating and melting the rubber.

Cure: Keep belt taut, and sheave grooves free of oil and grease. Check machine for overload.

OIL-SWELLING *Cause*: Belt is is swelled and weakened by chemical action of oil.

Cure: Provide splash guards, or use Oil-Resisting or Oil-Proof Texrope Belts.



ABRASION — *Cause*: Abrasive dust wears the sidewalls, narrowing belt width. Then belt slips, rides on bottom of groove.

Cure: Provide dust guards, keep proper tension.

4 CHECK BELT ENGINEERING

Because Allis-Chalmers belt development during wartime followed the familiar pattern of many industrial achievements—moving swiftly and outmoding many previously-acceptable types—it is *not* wise policy to replace belts by blindly ordering the same kind used in the old installation. Belts have become specialized for better economy, safety and dependability. It is time now to take a look at qualities of the new belts, and to take advantage of the special properties they have been given through use of new synthetics in their manufacture.

NOTE: THE MATCHED-SET PRINCIPLE —When one or two V-belts in a set are worn out or damaged, remember that the remaining V-belts have stretched beyond their original length, making it impossible to put proper tension on an old set to which *new* belts have been added. Adding new belts is therefore likely to be false economy . . . the new belts will overwork, lasting for only a fraction of their normal life. Rather than throw good money after bad, always install a complete, scientifically-matched set, storing old belts to use as replacements in other old sets.

5 INSPECT SHEAVE WALLS

For smoothness—What makes a V-belt grip the sheave? Not mere surface friction, but the *wedging* action of the bending and expanding belt. So sheave grooves may be smooth . . . *should* be smooth, to minimize belt wear. Watch out for ridges or burrs in the groove walls; if they're bad, re-groove or replace the sheave. Increased belt life will soon pay the cost.

For straightness—The sides of the V should be *straight;* if they're not, drive won't be truly efficient, belt life will be short. Some sheaves — misaligned or in hard usage — get "shoulder wear" in groove walls. Lay a straight-edge against the wall, look for a light gap. If you find hollows deeper than the thickness of a playing card, sheave needs truing.

REPLACE? OR REGROOVE? You'll have to make this decision. Note this: where small, inexpensive stock size sheaves show need for re-truing of grooves, time and trouble can often be saved by scrapping them and replacing with new sheaves. It may pay out, however, to re-groove special or large-diameter sheaves, or to return them to the factory, where a nominal charge is made for this service.

RECONVERSION INVENTORY CHECK LIST FOR V-BELT DRIVES

1. Present Condition of Drive
2. Present Condition of Belts
3. Present Condition of Sheaves
4. Drive Engineering
5. Belt Engineering

Ask A-C for sample copies of this V-Belt Drive Inventory Check List.

CENTRIFUGAL PUMPS, ELECTRIC MOTORS NEED INVENTORY TOO!

All three of these common industrial units — V-belt drives, centrifugal pumps, and electric motors — are covered in Allis-Chalmers' new *Reconversion Inventory Kit*. No big package, this Kit is simply a set of Fact Sheets and Check Lists, with suggestions for Inventory procedure as outlined on these pages but in slightly more detail.

A 1884

GET THESE FREE FORMS!

For your supply of Reconversion Inventory Kits, covering V-belt drives, centrifugal pumps, and motors, call your nearest Allis-Chalmers district office or distributor, or write Department 106, ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

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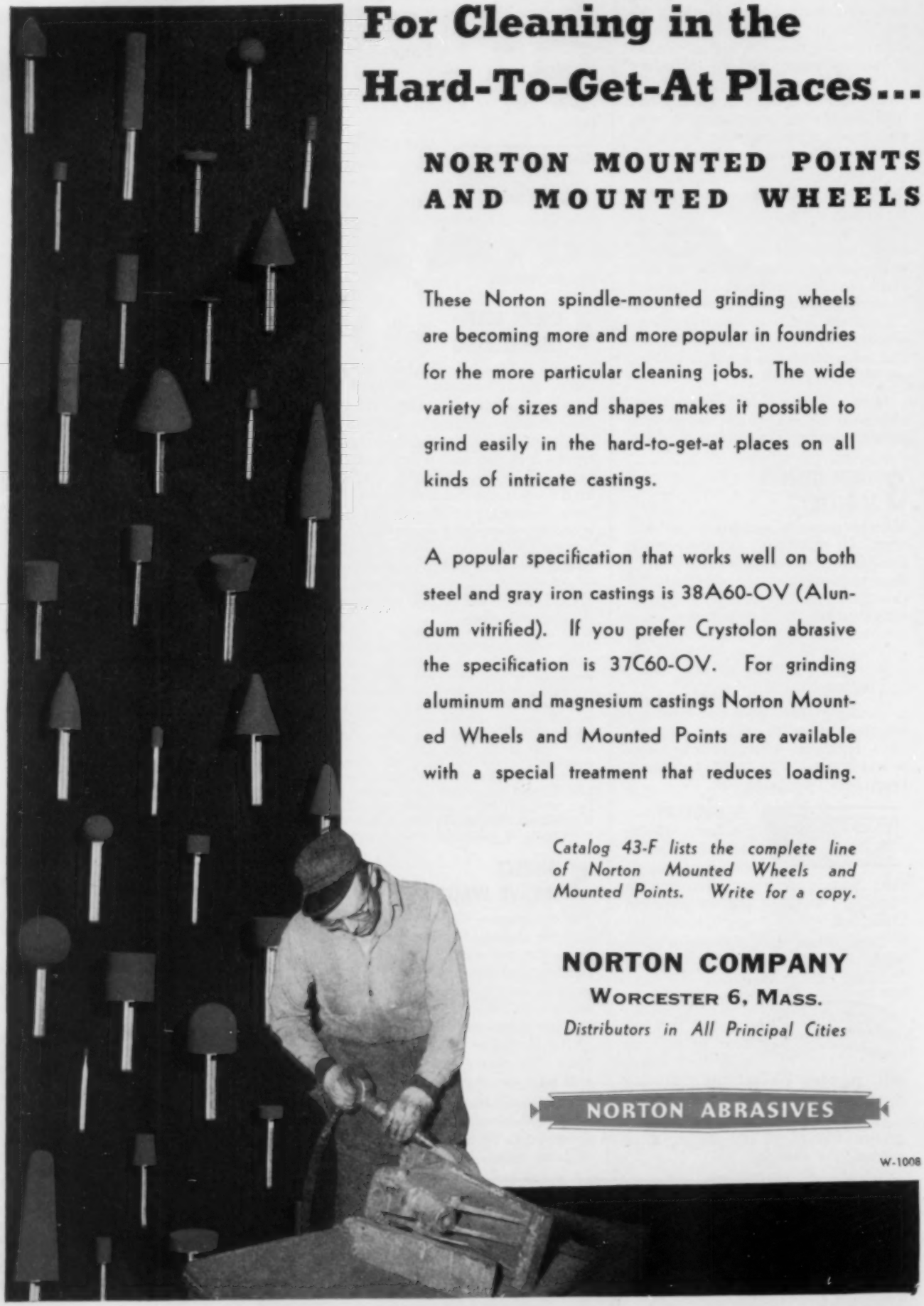

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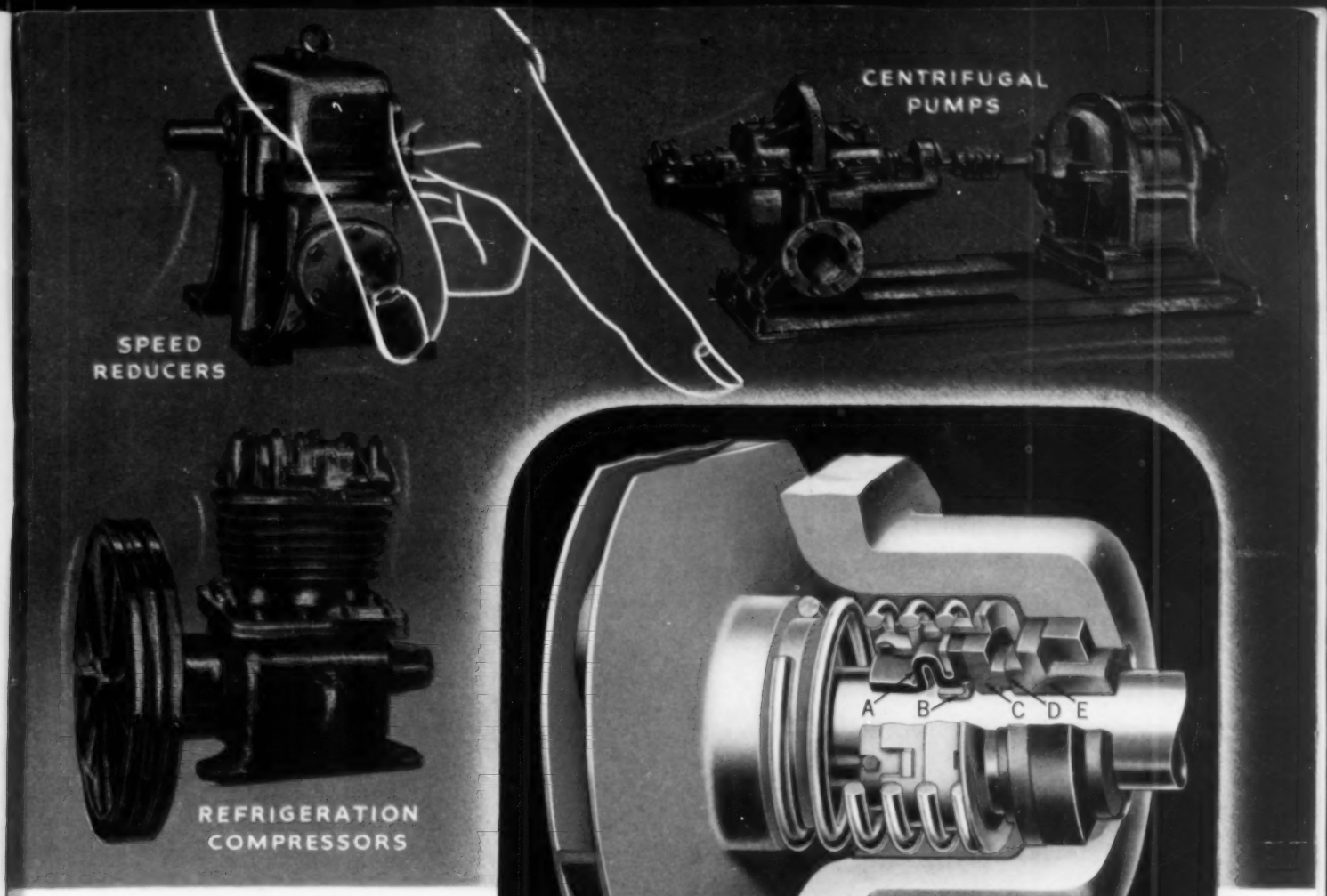

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A Caldron of Victory

IN MECHANIZED WARFARE, the issue of battle is decided not on the fighting front alone, but also in the metal-working establishments of the home front. Fighting men, no matter how courageous and how well trained they may be, are at the mercy of the enemy if he has the better mechanical equipment. Germany won her initial quick successes because she was superior in both men and material to the nations she overran.

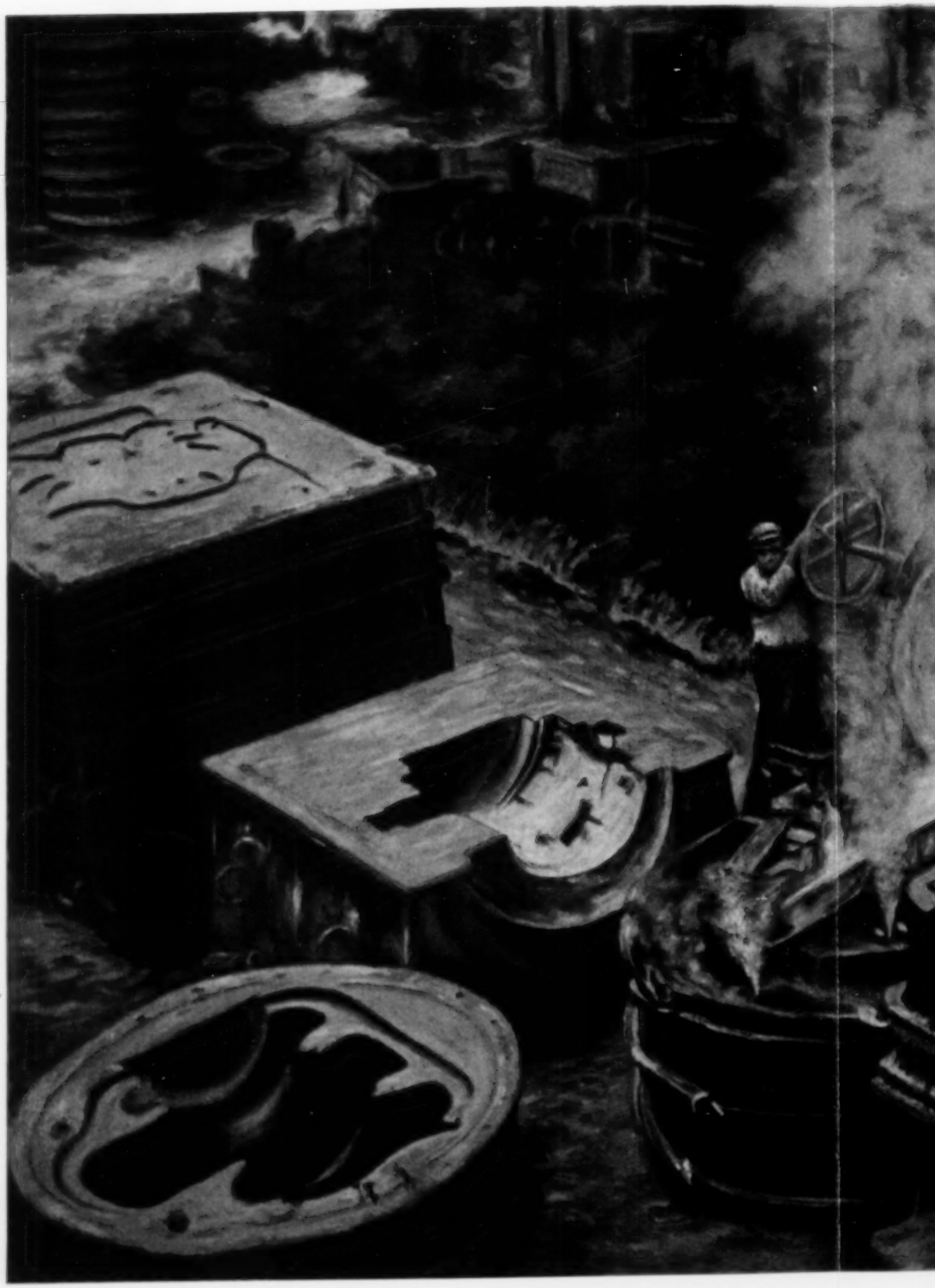
The marshaling of American might in this war has involved not only the training of men in military tactics, but also the building of ships, tanks, airplanes, guns, and countless other mechanical things. Our once soft military and naval fists are now able to deal telling blows because they are well sheathed with steel. Our armor has come from myriads of industrial plants scattered over the nation. In most of these the foundry is one of the starting points for the shaping of metal into usable forms. This painting then, may be considered as an industrial portrait that typifies an important link in the strongly forged chain of our war effort.

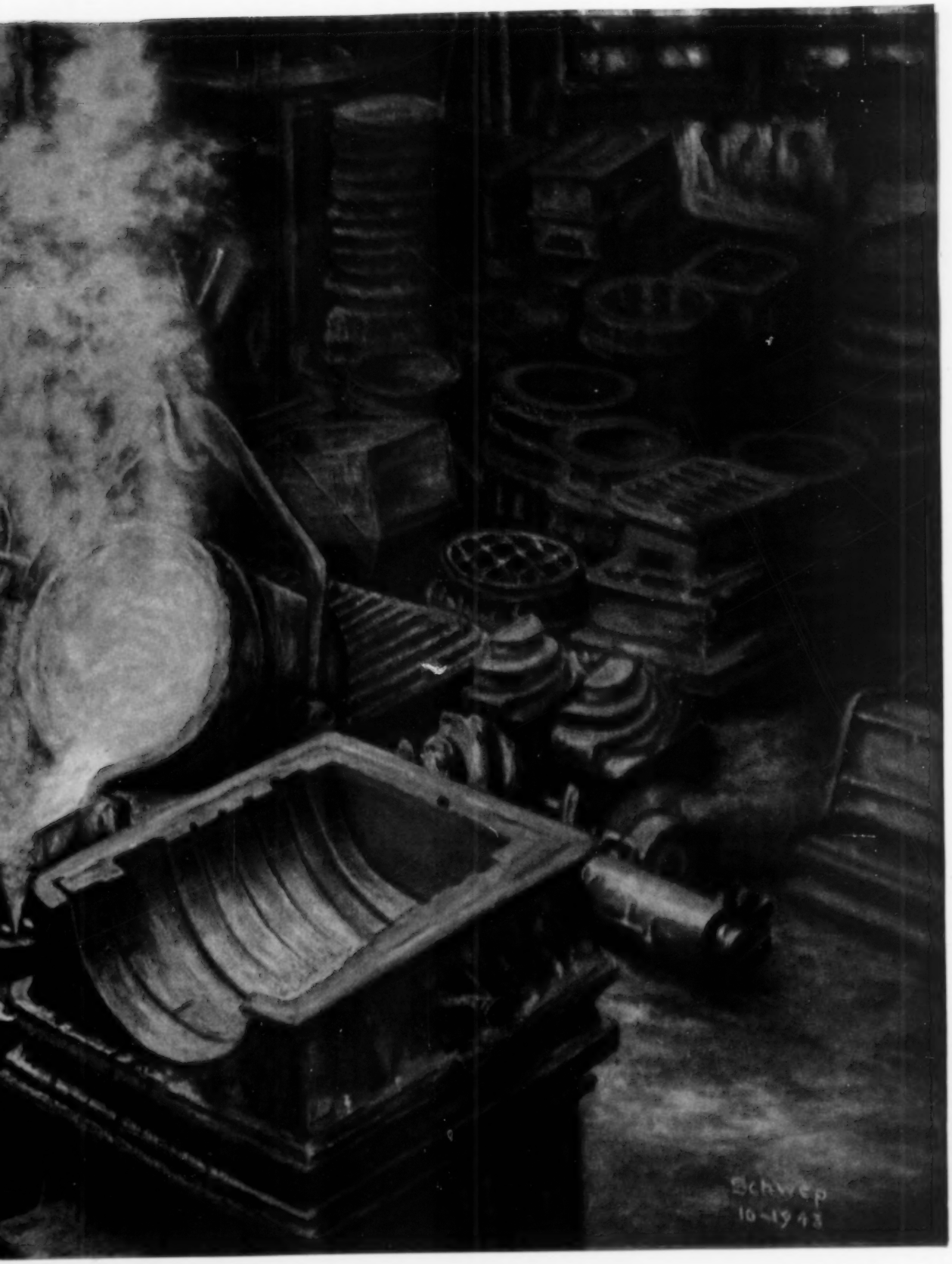
The painting shows a portion of the gray-iron foundry of Ingersoll-Rand Company at Phillipsburg, N. J. From it have come castings for compressors, turbo-blowers, pumps, condensers, oil engines, and other products for mines, steel mills, ships, oil refineries, synthetic rubber plants, powder plants, and hundreds of factories that turn out munitions of war. A 4-ton ladle is delivering molten metal to a pump casing mold. Other molds in the foreground are for forming parts of compressors and pumps, while a miscellany of flasks and pattern equipment is in the background.

The original painting was done in oil by C. FRANK SCHWEP, an industrial company executive who calls painting his golf.

★

A copy of the painting, unfolded and suitable for framing, will be mailed upon request. Address, Editor, Compressed Air Magazine, Phillipsburg, N. J.

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ON THE COVER

THE development by our Navy of the ABSD's—short for Advance Base Sectional Docks—has been a leading factor in conducting naval operations far from major land bases. Created by the Bureau of Yards and Docks, these structures were built in separate sections and moved as close to combat zones as possible. There the parts were welded into huge floating docks with capacities of from 56,000 to 100,000 tons—more than sufficient to raise our largest battleships. In one 8-month period they handled 176 ships, and oftentimes a vessel was repaired and returned to duty in less time than would have been required to move it to a major land base. Our cover picture, which reproduces an official U. S. Navy Photograph, shows a cruiser of the Cleveland class in an 8-section dock. An article on these sectional docks is now in course of approval by the Navy Department and will be published in an early issue.

•

IN THIS ISSUE

ALMOST as simple as children's play blocks are the sectional steel pontoons of the Seabees described in our leading article. These boxlike structures speeded many of our troop landings and also were combined in ingenious ways to serve as piers, dry docks, and storage areas.

•

THE article on *Memories of 20-Mule-Team Days* (page 233) traces the development of borax mining and gives sidelights on some phases of former activities in Death Valley.

•

TO ACCOMPANY the foundry painting reproduced just ahead of this page, we present an article on cast iron that contains old and new facts concerning this highly adaptable metal that is finding wider spheres of usefulness resulting from increased technical knowledge about its composition and handling.

•

THE speedy repair of engines was an essential step in keeping Army bombing planes fit for war service. It was accomplished on schedule, according to the Air Technical Service Command, largely through the extensive use of air-driven tools (page 244).

•

THE electric eye, which sees all and never sleeps, performs many magical feats in industry. One interesting adaptation of it is the sorting of various foodstuffs, as described on page 246.

•

ON PAGE 248, in *Big Ben is Not Silent*, we make amends for a previous misstatement concerning the famous British timekeeper and recount some of its history.

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The Navy's Steel Pontoons

Robert G. Skerrett

Official U. S. Navy Photographs

THE Navy's Construction Battalions—popularly known as Seabees—did remarkably fine and often spectacular work in the amphibious warfare we waged in the Pacific. Many of their accomplishments were the result of the use to which they put the novel pontoons developed for them in the Bureau of Yards and Docks of the Navy Department. Dubbed "Jeeps of the Seabees," they are comparatively small boxlike steel structures of shallow draft, easy to handle, and very adaptable.

As a means of bridging a waterway, the pontoon dates back to the days of ancient warfare. In the centuries that have followed, succeeding types showed betterments in design; but, even so, they remained cumbersome, more or less difficult to handle, and were well-nigh always restricted to a definite application. In the case of the one devised by officers of the Civil Engineer Corps in the Bureau of Yards and Docks something unusual was produced which was tremendously helpful to us in winning footholds on hostile shores.

To appreciate the value of the new pontoon in amphibious operations, it is necessary to keep in mind that, once our armed forces were transported overseas, there remained the critical period when the landing vessels had to head straight for the enemy's shore and disembark troops and their weapons to establish a beachhead from which to fan out and advance in force against the foe. Any pause or hesitation in these maneuvers might have led to failure or to a woeful loss of life, while surprise in the approach and dispatch in carrying out the landing were the best assurances of success.

An investigating committee of the U. S. Senate made a report last year that contained this revealing paragraph: "A successful invasion requires speedy and efficient means of transporting troops, supplies, and mechanized equipment, particularly tanks, in ship-to-shore and shore-to-ship operations. Shallow-draft, self-propelling vessels must be provided capable of carrying men and material through any sea conditions short of storm proportions and able to land on a beach in any reasonable seaway so that the combat load can be disgorged under fire in the shortest possible time. For tank lighters, a ramp must be provided at the bow which can be lowered the instant the vessel is beached and over which tanks or other mechanized units can be run under their own power. Such type of vessel, moreover, must be able to retract itself quickly from the beach even with a full load."

In substance, that was the problem facing the Bureau of Ships of the Navy Department, and for some years that organization wrestled with the complications involved. However, the boxlike pontoon was conceived and developed independently by the Bureau of Yards and Docks, a noncombatant branch of the service concerned with the possible establishing and equipping of extemporized bases such as might be required by our fighting ships, transports, and supply vessels should they be called upon to operate in alien waters under stress of warfare.

Among the officers in the bureau who had pondered the question ever since the conflict began in Europe was Capt. John N. Laycock of the Civil Engineer Corps of the Navy. But the subject which had been of casual interest prior to Pearl Harbor became an all-absorbing one thereafter. Then the overseas bases which had been largely mental pictures in 1940-1941 took shape in well-worked out plans. Among them was the boxlike pontoon that was to prove of such great value and to have a wider application than was originally contemplated

PONTOONS AS INVASION AIDS

Many of our landings on shallow beaches were made with "Rhino Ferries," formed by linking together small pontoons. The picture in the center shows a test run being made with one of the ferries in preparation for the Normandy invasion, where this type of craft proved to be a "secret weapon" of great worth. Above, a bulldozer is being unloaded from an LST onto a causeway built of pontoons and extending to the shore. One of these causeways over which men and materials moved at Licata, Italy, is seen on the opposite page.

for it; namely, to serve in groups as improvised piers and lighters where docking facilities were lacking so as to effect the necessary movements between ship and shore and *vice versa*.

The basic idea of the pontoon originated with Captain Laycock, and other members of the War Plans Division subscribed of their best in working out detailed construction plans. A full-scale mock-up of wood was guardedly built in a vacant office in the Navy Department; and when found generally satisfactory, a working model was made and equipped with the fixtures by which a number of pontoons could be linked together in several ways for various purposes. Then the Bureau of Yards and Docks tried for some months to arouse interest among companies experienced in the construction of river barges and kindred shallow-draft craft. Most of them were engaged on lend-lease or other contracts, and were reluctant to undertake the experimental work entailed in developing shop methods by which the few pontoons desired in 1940 could be turned out possibly on a quantity-production scale. It was essential that some of those concerns be won over, and Captain Laycock took upon himself the job of selling the idea.

Possessed of native ability, Captain Laycock set about making a considerable number of small-scale models that could be used to demonstrate the main features and the adaptability of his pontoons. He promptly commandeered every empty cigar box available, and with a sharp knife fashioned them into miniatures to show how the pontoons could be linked together and braced so as to give them a high measure of strength and rigidity when assembled in groups of "strings" to serve as piers, lighters, or platforms for floating derricks like those employed in loading or unloading vessels. His salesmanship finally won over the Pittsburgh-Des Moines Steel Company, and a contract was awarded that concern in February, 1941, for enough full-sized steel units to form a barge of 50-ton capacity, a dry dock capable of accommodating a craft of 100 tons, or a sizable seaplane ramp.

The boxes were constructed at the steel company's plant on Neville Island, just below Pittsburgh, and were tested on the Ohio River. The demonstrations were so satisfactory that a large number was immediately ordered by a certain friendly nation under Lend-Lease arrangements. From then on, orders for more and more were placed, and when we joined forces against the Axis powers scores of plants throughout the country were engaged in the mass production of Laycock pontoons. The various builders coöperated in improving the technique of quantity output; and by the time we had to have the structures their cost had

MARINE WEDDING

The Navy calls this act "marrying" a Rhino Ferry to an LST. It shows Seabees engaged in making the final link between the bow port of a landing ship and a causeway of pontoons.

dropped greatly and we were able to get the thousands we needed for service on the other side of the Atlantic and in the battle areas of the Pacific. Shops also qualified in making the special fittings designed by Captain Laycock to tie and lock the units together, and for these, too, stamping or forging methods were devised to supplant the machine work at first used in turning out the parts, which the Seabees have dubbed "jewelry."

Each pontoon is a steel box of welded construction, and standard units are of only two sizes and patterns. One—the more widely required—is rectangular in shape and has an expanse, top and bottom, of 5x7 feet with a side depth of 5 feet. The other is also 5 feet deep but measures 7x7 feet, and while one end is rectangular the other end curves upward or downward to form either the bow or the stern section of an assemblage. A stern unit with the rear end curving down from the deck may be used to advantage as a ramp in landing operations.

With the exceptions mentioned, the two types are built to meet identical structural requirements. Each is tested for tightness with compressed air at 25 pounds pressure, applied internally; and the pontoon must be watertight and strong enough to resist the hydrostatic pressure at a submergence of 28 feet. The deck and bottom plating is ¼ inch thick to assure ruggedness, but the sides and ends are of considerably lighter material. The internal bracing provides ample stiffness to withstand the load and stresses induced by armored tanks, trucks, or other mechanized units that may move over the deck of a string of boxes, which is notably strong against torsional forces.

Each pontoon proper weighs a short ton, but with its special fittings, which include binding angles, the total weight is 2800 pounds. These appurtenances are ingenious devices that serve to pull the units in close contact with one another and to hold them securely so that the full strength of each contributes to the combined strength of the group. A fully equipped pontoon, when afloat, has a net reserve buoyancy of about 4 tons. As has been explained by Rear Admiral Lewis B. Combs, Civil Engineer Corps, USN., and Assistant Chief of the Bureau of Yards and Docks, the adaptable boxes can be strapped together with steel members in the form of strings or in other arrangements to serve as piers, causeways, wharves, bases for floating cranes, dredges, tugs, fuel and water barges, icebreakers, and even floating dry docks.

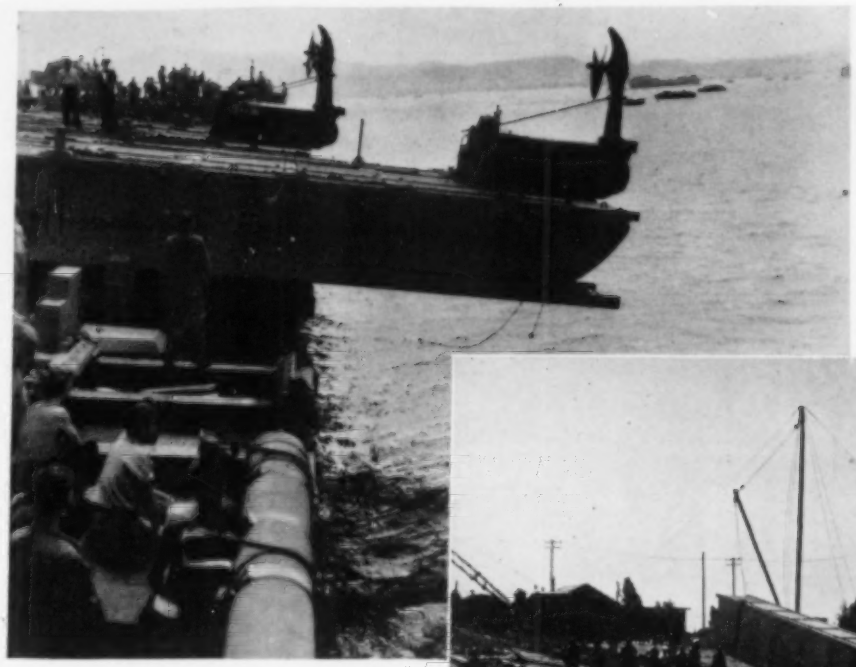
A string, which may be of any desired length up to 175 feet, is constructed by putting together as many of the 5x7-foot pontoons as may be needed. Each is placed so that its greater dimension is transverse to the axis of the string, and the length of the latter is the combined width of all the boxes, plus an interval of about 9 inches between contiguous units. By this disposition, the assemblage is given greater breadth and stability than it would have if the pontoons were linked end on, and they can also be tied together more effectively. Several strings may be joined and the length of the combination varied in accordance with requirements. A 10-ton crane, for example, can be placed on a pontoon barge 28 feet wide and 40 feet long composed of four strings of seven units each, numerically indicated as a 4x7 barge. Another, capable of carrying three oil or water tanks each of 1000-barrel capacity would have a width of 42 feet, a length of 103 feet, and would consist of an assemblage of 108 boxes. It would be known as a 6x18 barge.

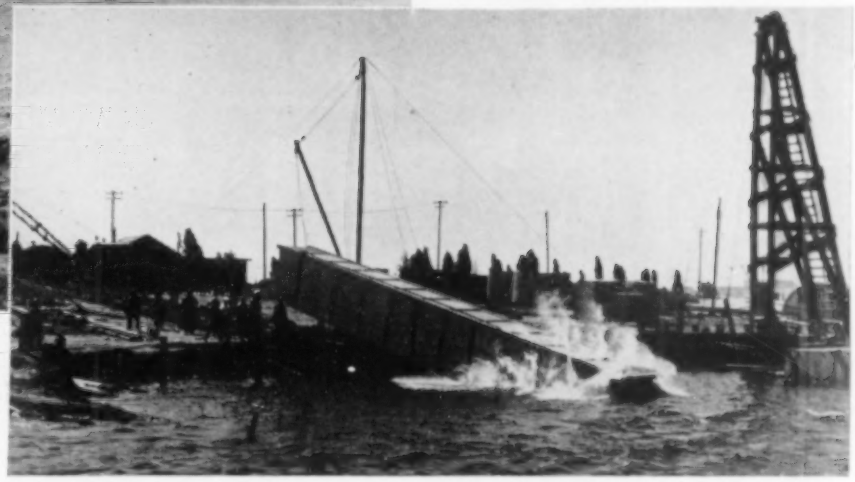
As can readily be understood, the pontoons are just "building blocks" to the officers of the Civil Engineer Corps to be used to meet a wide range of needs. Their disposition is not always in the horizontal plane. They may be stacked vertically when depth of water calls for their use as foundations or as stabilizing units when the boxes are to act as floating dry docks. If necessary, they can be given dead weight and submerged by flooding them with water ballast; and, conversely, their buoyancy may be restored and controlled by expelling the water with compressed air.

The pontoon barges may be equipped

USED AS A DRY DOCK

As this picture shows, the steel pontoon units are suitable for assembly into structures of varying shapes. Here they have been formed into a floating dry dock for servicing a vessel off the Florida Islands in the Pacific. Water is admitted into some of the blocks to cause the structure to submerge. The boat is then run in it, after which the water is expelled with compressed air. This causes the dock to rise, lifting the ship so that work may be done on its keel. The vessel in the dock is a landing ship for infantry.





LAUNCHING PONTOONS

The view at the left shows a string of pontoons being put overboard from a landing ship at Saipan in the western Pacific. Each string carries its outboard motor, with the propeller and steering gear turned upward temporarily. In the picture below, a string is being launched at a building yard and illustrates the stiffness of the assembly.

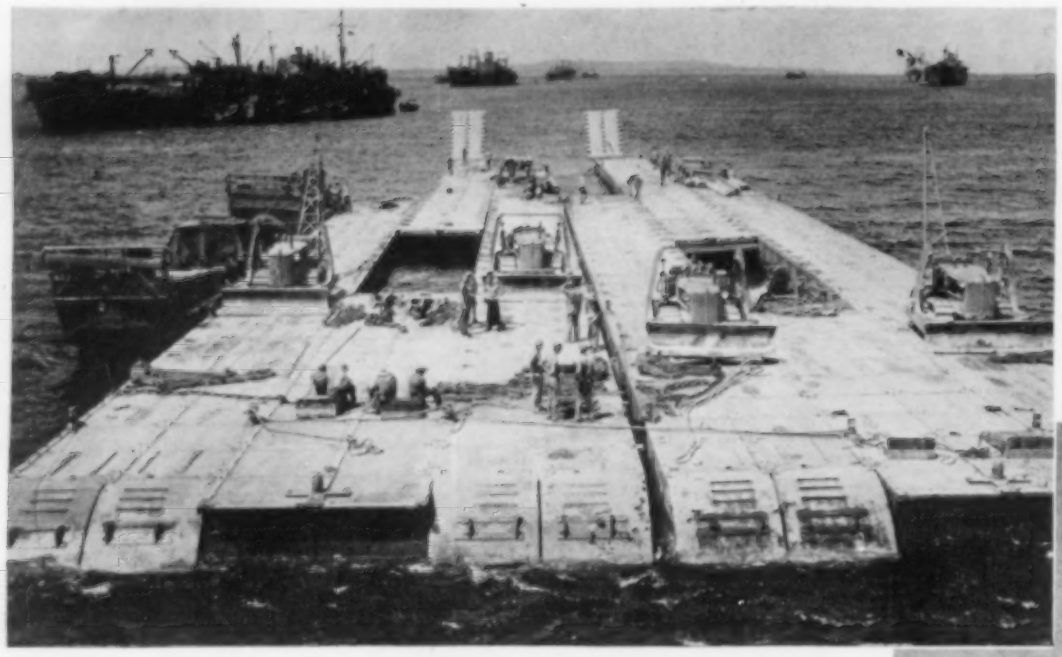
with either inboard or outboard motors for self-propulsion, and these so-called "Rhino Ferries" did astonishingly effective work in some invasion situations where their mobility answered the immediate problem of transport from ship to shore as nothing else could have done at the time. Two outboard motors of a particular American type can develop 143 hp. and drive one of these ferries at a speed in excess of 4 knots. Landing craft of this type are of much lighter draft than the big clumsy looking LST's (Landing Ships, Tank) which draw about 5 feet forward and are likely to ground at a considerable distance offshore where beaches shelve gradually or where outlying reefs or rocks would make close approach by a landing ship impossible. To evaluate what the pontoons did in forwarding our far-flung amphibious operations, a few records are cited.

Following testing of the first lot in the waters of the Ohio in the Spring of 1941, numerous pontoons were shipped to the Seabees' training base at Davisville, R. I., adjacent to Narragansett Bay. Groups of officers of the Civil Engineer Corps were also sent there to learn, with the Seabees, how to make the most of the boxes, particularly in coöperation with LST's in transferring tanks, motor vehicles, and other mechanized units from ship to shore where the depth of water would not permit an LST to shove her bow up on the beach. In this preparation at Davisville the Navy competed with the Army engineers who had developed elliptical, rubber pontoons that could be inflated and on which, when lined up and linked together, could be laid treadways or platforms over which heavy armored tanks could be driven, provided tidal conditions were favorable and rough water did not interfere.

When the day for the test arrived, the military group was on one LST, with the pontoons placed where they could be quickly dropped into the water. The Navy men, aboard a similar craft, sallied forth with two strings of pontoons towing alongside. Hitting a good clip, the two LST's headed for a chosen beach, holding their speed until they were slowed up and then halted about 500 feet short of the shore line. The Navy gang, as soon as their ship began to slacken pace, cut their strings of pontoons free, letting them surge onward under their acquired momentum until the leading one came to a standstill in about 2 feet of water and with its nose nearly on the beach. But before that happened, the other string was drawn backward by a hawser that led into the open bow port of the LST until its after end was in touch with the ramp of that vessel and the forward end overlapped the rear of the beached string, to which it was smartly secured by the Seabees aboard the pontoons. In less than ten minutes from the time the Navy's LST grounded, a power-driven heavy antitank gun had left the ship, sped over the causeway formed by the pontoons, and had reached the shore. The Army group was still busy getting its pontoons overboard.

That performance was kept secret by our armed forces because they knew that they had the making of more than one surprise for the Axis powers. The Army was quite ready to benefit by what the Navy had shown could be done with the Laycock pontoons, and a detail of the Army engineer force was sent to Davis Island to learn how to handle the steel boxes and to fit themselves for a difficult assignment for which the rubber pontoons were unsuitable. The job was at Ascension Island, an isolated volcanic formation in the South Atlantic that had been shot up from the depths of the ocean in the dim past at a point approximately midway between the easternmost bulge of Brazil and the coast of Africa.

Knowledge of the existence of Ascension Island dates back to 1501, when it was discovered by a Portuguese seafarer. But for the next 300 years and more, that formation of lava, 6 miles wide and about 9 miles long, remained uninhabited save by sea birds until the British established a garrison there to keep an eye on Napoleon at St. Helena, some 700 miles to the south and eastward. Later, the British Government placed a cable station there; but the small organization—employees, guards, and laborers—never rose to more than 300 until U. S. Army Engineers were given the job in 1942 of landing a large working force and roadbuilding machinery on the rocky shore despite all that Nature could do to hamper. The engineers were to drill, blast, and level a shoulder of the lava-covered crater of Green Mountain, which rises fully 2800 feet above the sea, and to construct a runway 7000 feet long on the shelf thus cut in the sharply sloping flank. Difficult as the task was, the men



put it through in the almost unbelievably brief time of a little less than three months. On July 10, 1942, the first plane of the Army Transportation Corps landed on Ascension Island to pioneer the new air trail across the South Atlantic between Brazil and the Coast of Africa.

The building of that airfield was a hush-hush undertaking; and the secret was well kept as long as necessary. Ascension Island lies in the sweep of the prevailing northwest trade wind that blows steadily and vigorously, and the lee shore is continually hammered by waves that surge against the rocks to a height of more than 10 feet. The first task of the engineer combat battalion was to effect a landing, and then to get all the machinery and supplies from the ship to safety well above tide level at the Georgetown landing.

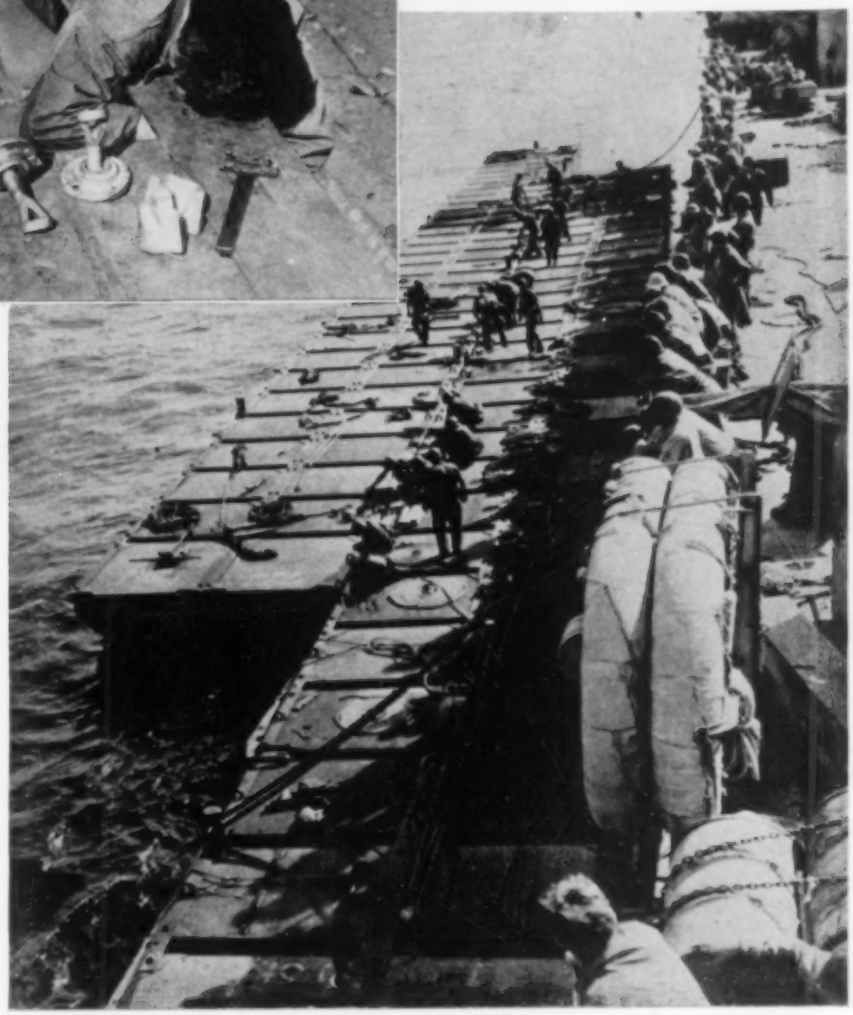
It was for this ticklish and hazardous task that Navy pontoons, with Army men in charge, were chosen. Their control in those troubled waters was much like guiding a large team of frightened runaway steers. Some of the units were sorely battered, and some of the freight was virtually hurled from them on to the landing; but in the end the unloading of the vessel was achieved and the pontoons were thoroughly tested for ruggedness and their ability to withstand wicked mauling. It can truthfully be said that those structures were indispensable in constructing the runway on Ascension—in creating a halfway station that proved to be of inestimable value in maintaining a flow of supplies to the battle zones in North Africa, Sicily, and other Mediterranean areas. Some of the boxes also served the island as fuel tanks and were the means of keeping up vital supplies of fresh water at critical stages.

At the time of our landing on Guadalcanal, Tulagi, and the Florida Islands in August of 1942, the Jeeps of the Seabees were of the greatest aid to our fighting men. They were used as landing barges and piers, and as a means of taking care of the PT boats that did such effective work against Japanese ships that repeatedly strove to drive out our armed forces in the early days of the campaign in the Solomon Islands. The structures functioning as dry docks made it possible quickly to repair not only damaged PT's but also seaplanes.

Noumea, in French Oceania, became our most important advance naval base soon after we took the offensive in the Pacific. In a short while the very limited port facilities of that place were overtaxed; the beaches were crowded with stacks of myriad supplies; and vessels could discharge and load mainly by barges and lighters. In that situation Navy pontoons saved the day by forming piers and docks and by functioning as transfer barges that were self-propelled, as dry docks, and as supports for floating derricks. After that, the Bureau of Yards and Docks ceased to depend wholly upon pontoons built in the United States and, from time to time, established assembly depots, commonly known as PADs, at strategic locations. To these the materials were shipped flat from this country, saving much precious cargo space. The assembling was done by Seabees who were qualified to do the work or who were trained within a short period on the spot.

When we defeated the Axis in Tunisia and brought organized resistance to a close in North Africa in 1943, the Allies, after a month's preparation, were ready to strike Italy by attacking her through Sicily. Landings were made on the east and south coasts of that island on July 9 of that year, much to the surprise of the German strategists who had assumed that the Allies would seek to invade Sicily elsewhere and had concentrated at other points. Our strategists, however, planned to disembark where there was shallow water far out from the beaches and where the enemy believed we could not attack because our ships would ground hundreds of yards out from the shore line. The foe was unaware of the Navy's pontoons and how they could be maneuvered after strings of them were dropped overboard to surge beachward under the momentum imparted to them just before the landing vessels grounded.

The water gaps at Licata were thus quickly bridged by floating causeways between shore and ships, permitting steady tides of tanks, ammunition, and mechanized facilities to pour on to the hostile but insufficiently protected terrain. The enemy's gunfire tore into some of the landing craft; but, even so, the pontoons made it possible for "more than 10,000 pieces of motorized equipment to get ashore and to deliver the



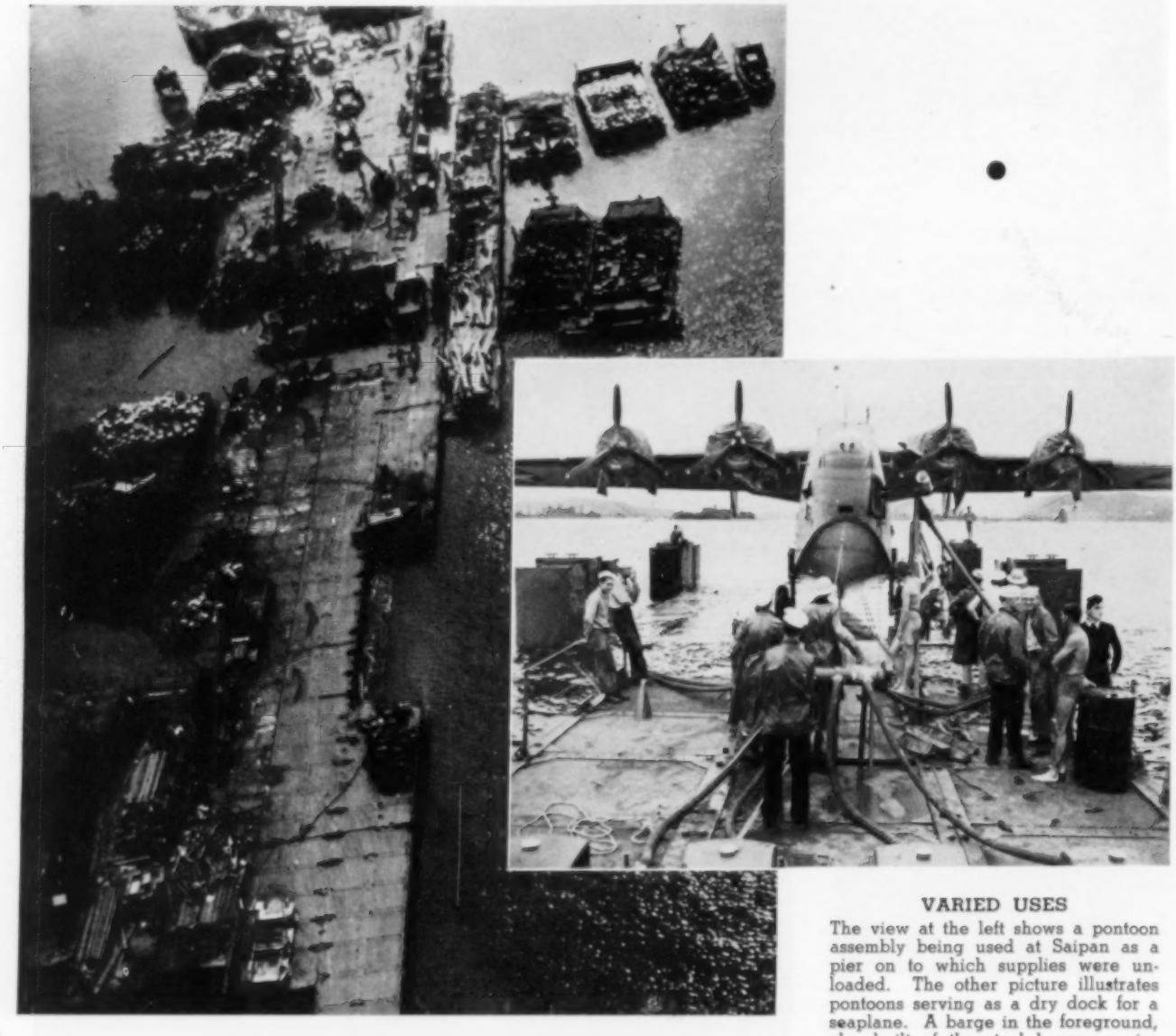
PUTTING THEM TOGETHER

At the extreme left, Seabees are shown at conquered Saipan assembling a pontoon causeway to be used at Tinian, another island in the Marianas, which was invaded shortly afterward. The lower center picture was taken from the shore of Kwajalein Island while pontoons were being lashed together into a steel roadway. A close-up of Seabees undergoing training in joining pontoons is at the left. They are drilled in the operations until they can perform them faultlessly even when exploding bombs and shells make concentration difficult. The view below shows Seabees joining two strings of pontoons that have been dropped overboard from a landing ship, on which kibitzing shipmates line the rail.

initial blow that foreshadowed the defeat of Sicily's defenders. During the action a landing ship was bombed and set ablaze, but the troops aboard were saved by a causeway that the Seabees quickly placed between the stricken boat and another neighboring vessel that afforded a haven.

Pontoons performed splendidly later on when the Italian mainland was invaded at Salerno and at Anzio, but did so against fierce resistance that caused heavy losses among the men maneuvering the craft. This was because the enemy had profited by the lessons impressed on them in Sicily and had taken steps to hamper the operations of the pontoons. The Jeeps of the Seabees also had their jobs cut out for them when D-day landings were made on the coast of Normandy. Again to quote Rear Admiral Combs: "Army, Navy, and Marine officers returning from these difficult operations have repeatedly reported that their success was due largely to the Navy pontoon."

To jump from our participation in the war in Europe to the wider-flung actions in the Pacific, perhaps a single instance of how the steel boxes were used to outmaneuver the Japs will give a good idea of their adaptability. Kwajalein atoll in the Marshall Islands group was very much of a Nip stronghold when in January of 1942 a raiding force of our ships attacked it with bombing planes to discover the defenses and the character and layout of that reputed key position. This was preliminary to the climacteric attack which was made two years later, almost to the day, when we landed in strength and routed the enemy. During the second operation the assaulting troops would have drawn the concentrated fire of the foe had he not been distracted by a flanking attack with howitzers from a nearby small island of the atoll. That islet was invaded from a large landing craft with the aid of a pontoon causeway over which ammunition was hauled for the howitzers. After the dominating points had been taken by our assaulting force, Seabees established a number of similar causeways on the shore of the lagoon to permit the land-



VARIED USES

The view at the left shows a pontoon assembly being used at Saipan as a pier on to which supplies were unloaded. The other picture illustrates pontoons serving as a dry dock for a seaplane. A barge in the foreground, also built of the steel boxes, carries portable compressors that supply the air for regulating the buoyancy of the dry dock, enabling it to lift a plane out of the water for repairs.

ing of mechanized construction units that repaired the important airstrip. By way of contrast in locale, we obtained our foothold on Attu in the Aleutians with Navy pontoons and were thus greatly aided in driving the Nips out of their desperately held positions there.

Undoubtedly, one of the most valuable and ingenious adaptations of the pontoons is their use as floating dry docks, which made it possible to repair or overhaul vessels and seaplanes that could not have been moved long distances to shipyards or established naval bases and that would, therefore, have been counted ineffectual or as losses. These docks can be built up of from 60 to approximately 280 boxes, with a lifting capacity ranging from 100 to substantially 500 tons. The structure is in the form of a main body composed of pontoons and has the appearance of a barge. Other pontoons, arranged vertically at the two long sides, act as stabilizing towers to hold the dock on an even keel when its deck is more or less submerged. To each of the boxes constituting the deck are led air lines from a manifold drawing air from portable compressors mounted, together with the manifold, on an attendant barge that is connected with the dry dock and is also made up of pontoons.

To sink the dock so that it may receive a ship it is only necessary to open flood valves, thus venting the air from the boxes and admitting water. To make the dock emerge and to take up its burden, the air vents are closed and the chambers are filled with compressed air, in that way forcing the water out through the openings that admitted it. Control of the water ballast makes it possible to keep the dock on an even keel while submerging or rising. The compressed-air plant consists of two or more portables, depending upon the size of the dock, and also provides air for operating pneumatic tools for various purposes.

The floor of the dry dock carries an adjustable cradle that serves to support the craft received for repairs and to hold it steady until the dock is submerged and the vessel is free to float again. Catwalks, held by the wing walls or side towers, enable attendants to move from point to point above water, to run and handle lines when a ship is being centered over the sunken dock or steadied during refloating after repairs are made.

The Navy pontoons performed many essential services in our far-flung amphibious operations; and it is inconceivable how we could have met innumerable difficult situations without these simple but amazingly adaptable boxlike steel structures. It is therefore understandable why in August of 1943 the Chief of the Bureau of Yards and Docks, Vice Admiral Ben Moreell, presented the Legion of Merit to Captain Laycock in recognition not only of his pontoon and its contribution to the war effort but also for other types of equipment that he conceived and that served us well in combat areas.

Memories of 20-Mule-Team Days

C. H. Vivian

ONE of the most absorbing industrial romances of the Old West was the production of borax in Death Valley and its transportation across the desert by 20-mule teams. Compared with gold, borax is a prosaic substance, yet it is so important to our civilization that men braved the sun's burning rays in this arid inferno to procure it, and the tales that came out of that pioneer business endeavor rival any that the gold camps produced.

Although it has been more than a quarter-century since the 20-mule teams traveled the dusty desert roads, radio audiences have in recent years become familiar with life as it was then lived through the "Death Valley Days" programs sponsored by the Pacific Coast Borax Company. The episodes presented were based on actual happenings and peopled with real characters, thanks to thorough research and skillful writing by their author who, incidentally, is not an old sourdough at all but a young

20-MULE TEAM

Until 1918, these teams hauled borax 162 miles across mountains and desert from Furnace Creek in Death Valley to Mojave, Calif., the nearest railroad point. There was no house or other habitation along the route, and one stretch of 60 miles was without water. The temperature ranges from 136 to 150°F. in the sun, which shines down from an almost cloudless sky. A team could cover from 16 to 18 miles a day, and camp was made each night. Sufficient provisions for man and beast for the round trip were loaded on the wagons at Mojave, and on the way to the valley the supplies for the return journey were left at each camping place.

The teams traveled on a definite schedule, and were on time more often than the railroad trains of that era. The wagons, which were reputed to be the largest and strongest of their kind, were built in Mojave. Each cost $1000 and held 12 tons or a carload of borax. Two of them, together with a trailer tank wagon that contained 1200 gallons of water, constituted a train. Each wagon weighed 7800 pounds, and the combined weight of the two, loaded, exclusive of the hay, grain, and other provisions, was more than 60,000 pounds. However, there is no record that one of them ever broke down on the road during the many years they were in service.

The mules were all selected for their intelligence, and were trained to know their names and to obey any command from the driver. A chain 120 feet long extended from the front wagon to the lead pair, and each span was connected to the chain by a set of singletrees and a doubletree. The driver rode the near nigh mule and communicated his signals by means of a line running through rings on the harness of the nigh animals up to the leaders. A light iron rod called a jockey stick, with a snap hook on each end, connected the leaders. One end of it was fastened to the chin strap of the off mule, the other to the hame ring on the offside of the nigh mule. A steady pull on the line caused the team to go to the right, while a jerk turned them to the left—hence the name "jerk" line.

The "captain" of the team was the nigh leader, and the smartest animal was given that position. Much depended upon how intelligently it did its work. In rounding a sharp turn it was necessary, in order to keep the chain in the periphery of the curve, for some of the mules behind the leaders to leap over the chain and to pull almost at right angles to the direction of travel—to step along sideways. At each stopping place they were unhitched, and the chain, with singletrees and doubletrees attached, was left extended straight out in front of the wagons. In the morning, after being harnessed, the animals walked to the respective places at the chain, although the positions were unmarked.

The driver had to know his mules and to be able to handle them under all conditions; to take care of them when they got sick; and to replace any shoes that came off. He also had to be something of a wheelwright in order to make any needed repairs. The best driver was Bill Parkinson, better known as "Borax Bill." He had the most expressive vocabulary, and, when occasion demanded, backed up his verbal commands with a blacksnake whip.

An assistant, called a "swamper," accompanied the driver. He fed and watered the mules, built the fires with sagebrush and greasewood, cooked the meals, and did odd chores. When the team was going downhill, he applied the brake on the second wagon, the driver manipulating that on the front wagon with a leather line extending to his saddle on the nigh-wheel mule. When going uphill, the swamper walked alongside the team.

woman whose home is within commuting distance of New York City.

The United States still produces more than 95 percent of the world's borax, and the Pacific Coast Borax Company accounts for a large proportion of it. Its output, however, now comes from mines in southern California. Silence reigns over the Death Valley borax workings, but the Pacific Coast Borax Company has retained most of its holdings there and operates hotels at several points for the convenience of tourists or health seekers who find the desert interesting or beneficial. Some of them have accommodations to fit any pocketbook.

One of these hostelries is the Amargosa Hotel at Death Valley Junction where, to keep alive memories of days past, an area of the property has been set aside as a museum for the exhibition of relics of mining activities that once flourished in the valley. The company's viewpoint on this display is expressed by H. P. Gower, superintendent of its refineries at Los Angeles, as follows: "While we of course favor progress and welcome paved roads and tourist hotels, we regret that the mystery and romance of the old prospector and miner are being eclipsed by more modern things. We have accordingly dedicated a small corner of our grounds to mementos of a bygone day." The accompanying pictures show some of the exhibits.

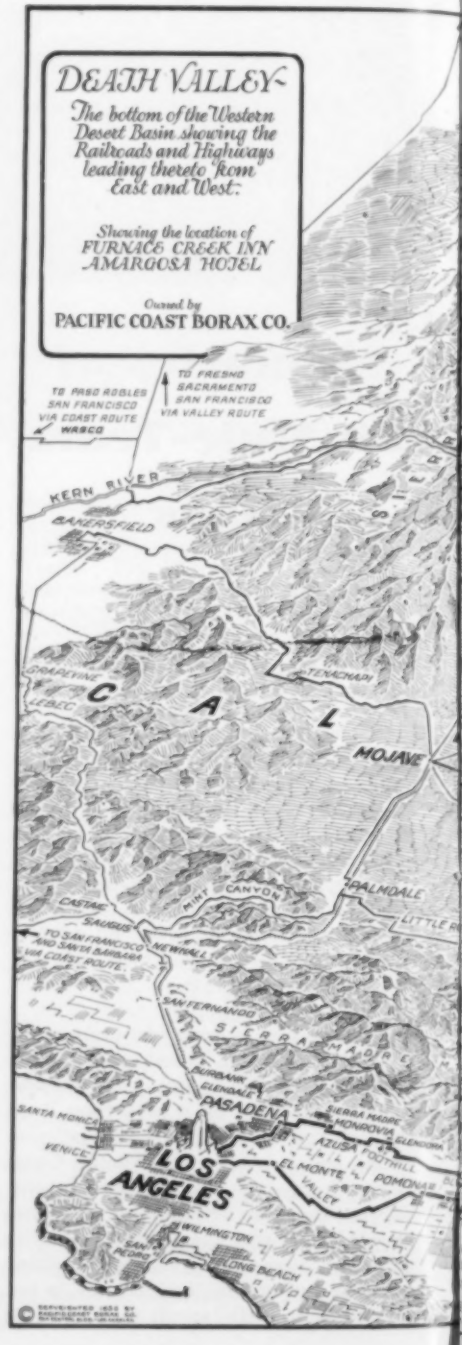
Pure borax is a sodium borate containing ten molecules of water. In its natural state it frequently also contains calcium, the Death Valley mineral ulexite being of this type. Borax is familiar to all housewives because of its cleansing properties, and it is an ingredient of many soaps. The facility with which molten borax dissolves metallic oxides has led to its use through the ages as a flux in welding and brazing. For countless centuries it has likewise served to impart a high glaze to pottery, tile, porcelain, and china, the finish of our bathtubs, kitchen sinks, and highway signs attesting to its vitreous quality. It is an essential component of Pyrex and of other heat-resistant glasswares and is used in photography for making negative developers, in the textile and leather industries, and for fireproofing fabrics.

Boric acid is a well-known eyewash, and tooth powders and mouth-washing fluids contain sodium perborate, yet boron carbide is the hardest-known substance except the diamond. Boron compounds contribute to the quick-drying and fire-retarding properties of some paints, and others enter into medicines and cosmetics. Comparatively recently it was learned that borax has an important effect upon the growth of plant life. Soils lacking boron often cause nutritional disturbances in growing things and induce deficiency diseases. Consequently, borax is being included in some fertilizers; but as the requirement varies with different plants, research is now being conducted to ascertain where and in what amounts it is beneficial When these investigations have been completed it may come into more general use in this field.

Borax has been an important article of commerce for many hundreds of years. It was in demand as long ago as artisans of the Orient made silverware and fine china. The earliest recorded production was at Tibet, where the mineral was obtained in the impure form known as tincal from semidry lake beds. Coolies carried it on their backs thousands of miles to the ancient cities of India and China. Centuries later it was introduced into Europe, the Tibet deposits remaining the sole source of supply also of that continent until boric acid was discovered in the steam and vapors issuing from the Tuscan lagoons of Italy. Still later, beds of calcium borate were located at Panderma in Asia Minor, and these were afterward worked extensively.

Less than 100 years ago, all the borax used in the United States had to be imported. The first domestic deposits were found in 1856 in Little Borax Lake, Lake County, Calif. The mineral existed as crystals in the mud along the shores, and a small refinery for purifying them was operated there in 1864-65. Curiosity on the part of a teamster hauling silver ore from a Nevada mine to the nearest railroad was responsible for the next discovery of borax. Each time he drove back and forth he observed in the distance a white patch of ground shimmering in the sunshine. Finally he decided to investigate it.

When the driver got there, he found an alkaline incrustation on the surface of what later became known as Teal's Marsh. The material had a sweet and salty taste, but he didn't know what it was, so he filled his saddlebags with it and went back to the mine. Samples were sent away to be tested, and the report came back that it was ulexite, a hydrous sodium-calcium borate. The teamster quit his job forthwith and with others organized the Pacific Coast Borax Company, which has developed into the leading concern in the borax industry. The teamster was F. M., better known as "Borax," Smith, and he became president of the company he founded.



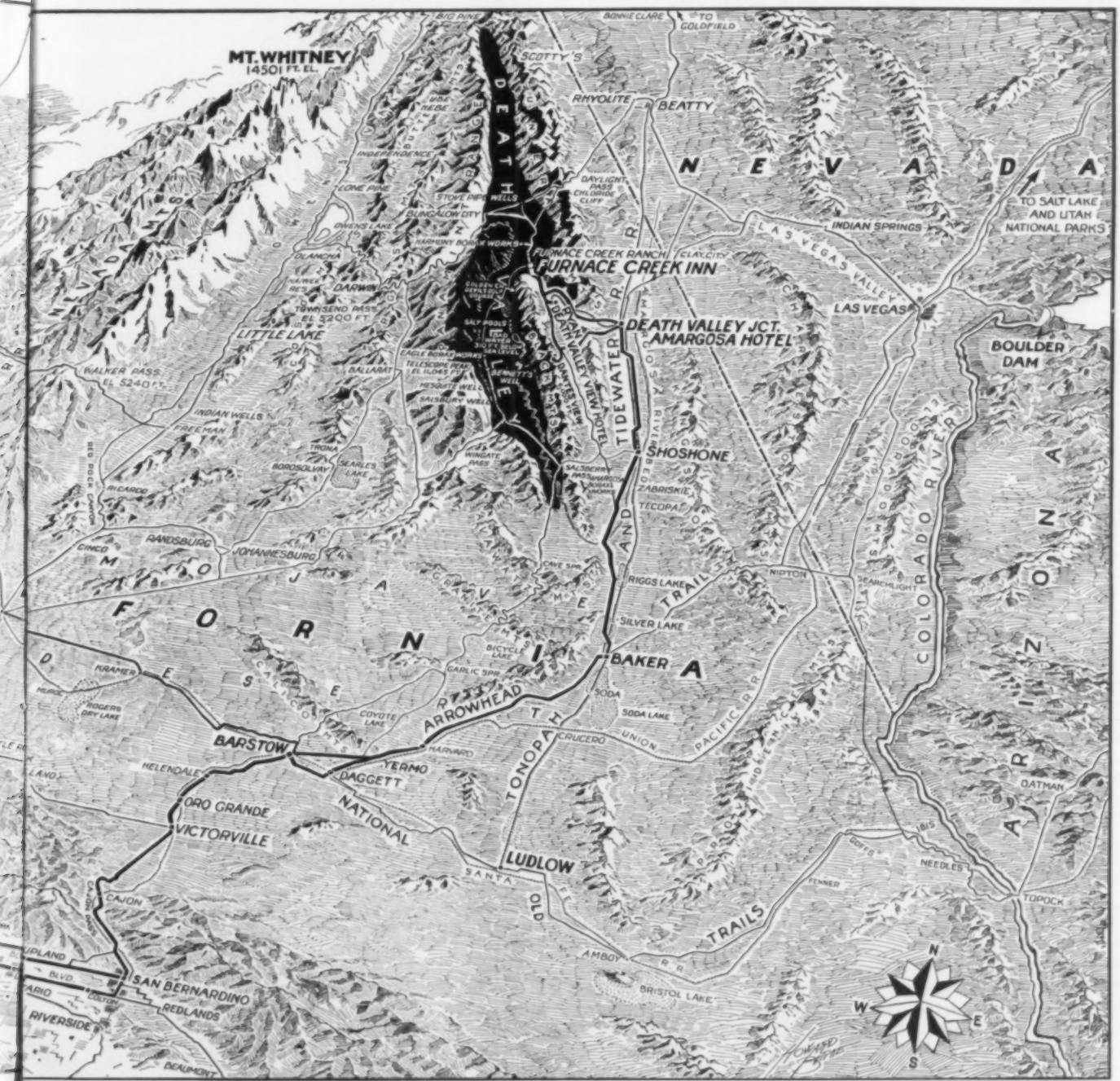
THE BORAX COUNTRY

Death Valley, a depressed area north of the Mojave Desert, lies principally in Inyo County, California. It was named for a party of "49'ers" who perished there while en route to the Pacific Coast. Although its lowest point is 310 feet below sea level, it is only 80 air miles from Mt. Whitney, highest peak in the country. The valley is rimmed by mountains, some of them more than 11,000 feet high, and is the final concentration area for salts carried by streams from an extensive drainage area. This accounts for the deposits of borax, nitrate of soda, and other minerals. The Amargosa River enters the valley from the south, but decreases in size and then disappears entirely. The temperature is rarely below 70°F. in the shade, and official readings up to 134° have been recorded. The 20-mule borax teams traveled between the valley and Mojave, located near the letter "I" in "California." Borax is now being produced from underground mines east of Mojave near Kramer; also from Searles Lake and Owens Lake. This map was made in 1930 for the Pacific Coast Borax Company and shows modern roads leading to Death Valley.

Smith's discovery led to the identification of the Death Valley deposits, which had been viewed by many but recognized by none. Among those who had been there was Aaron Winters, and when he heard of Smith's find he decided to go back to Death Valley for another look at the white mineral he had seen there. Before starting out, he learned how to make simple tests for borax. Applying a flame to some of the mineral he had gathered up, he said to his wife: "If this burns green, we're rich." It burned green. Winters built a small refinery where the borates scraped up from the salt flats were concentrated.

Hearing of these two developments, W. T. Coleman, a San Francisco commission merchant, decided that he would try to get into the lucrative borax business. (The mineral was then selling at $400 a ton.) He went to Death Valley and had no difficulty in finding borates, for they were plentiful. He also constructed a refinery, and the remains of his and Winters's plants are still to be seen. After a time, Winters sold out to Smith. For a short period thereafter Coleman, operating the Harmony Borax Works, and Smith, doing business at the Eagle Borax Works, were competitors, but then Smith enlarged his holdings by buying out his rival. It was from these two properties that the 20-mule teams afterward hauled borax to the railroad at Mojave. Coleman's name was given to the mineral colemanite, a hydrous calcium borate that abounds in Death Valley and is also obtained from underground deposits in California, from which most of our borax now comes.

The Mormons extracted borax at several Death Valley points prior to 1900, apparently for their own consumption. One of the earliest operations outside of those in Death Valley was conducted by the Sterling Borax Company, which mined and concentrated colemanite near Lang, Calif. The workings were abandoned after the high-grade mineral had become depleted. The recovery of borax from the brines of Searles Lake, Calif., attained sizable proportions during World War I, and



production from that source still continues.

Smith's Pacific Coast Borax Company continued to grow, and refineries were established at Alameda, Calif., and Bayonne, N. J. Subsequently, production shifted first to Borate near Yermo in the Calico Mountains, and next to Death Valley Junction, where the Lila C. Mine was developed. By that time the railroad leading toward the valley had been extended, and the wagon haul was correspondingly shortened. The borax company then built the Tonopah & Tidewater (T & T) Railroad to connect the region with the Santa Fe line at Ludlow, Calif. A little later it opened a mine at Ryan overlooking Death Valley, and then lengthened the trackage to transport the mineral from there to a concentrating plant that had been put up at Death Valley Junction.

In 1912 a well driller, named John Suckow, discovered calcium borate near Kramer, Calif. Fourteen years later, Ralph Corum found sodium borate a few miles to the east. The Pacific Coast Borax Company bought both properties, and development revealed large masses of relatively pure mineral at depths of from 400 to 1000 feet. When the extent of those deposits was ascertained, production in Death Valley was stopped, and since then much of the world's borax has been coming from the underground mines. The town of Boron was built there on the Mojave Desert, and it is of interest to note that it is not far from the railroad station to which the 20-mule teams hauled Death Valley borax for many years. Extensive deposits still remain in Death Valley awaiting development at some distant time when the present sources of supply are depleted.

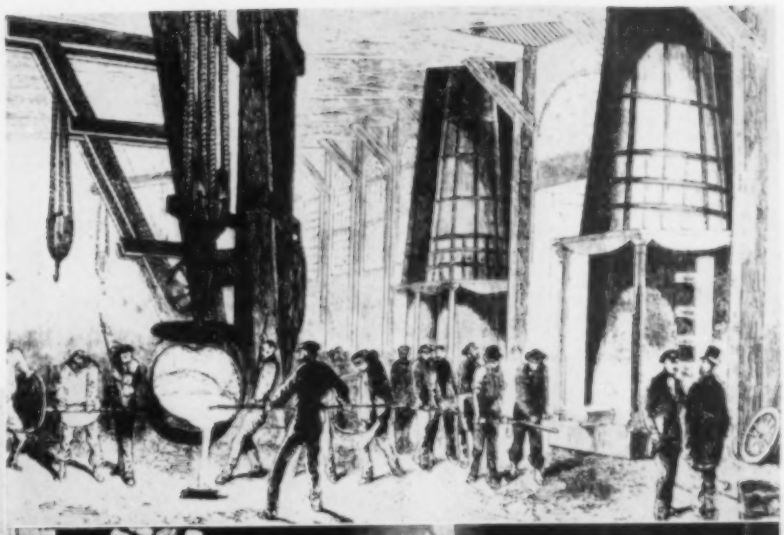
RELICS OF EARLY MINING OPERATIONS

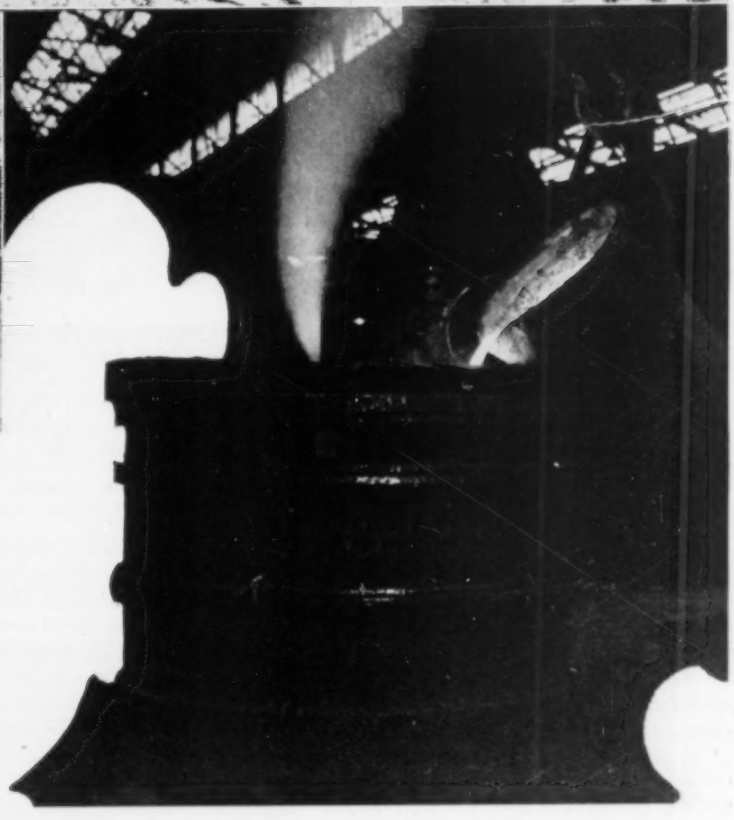
Pictures of equipment formerly used in Death Valley borax operations and now on display on the grounds of the Amargosa Hotel at Death Valley Junction. At the top-left is a bellows from the blacksmith-shop forge at Furnace Creek Ranch, 178 feet below sea level and for many years headquarters of the 20-mule teams. In the foreground lies part of a wheel from one of the wagons that once hauled borax from the valley. The ore car (top-right) was made by mounting a mine bucket on a homemade truck. It has many of the features of the modern type, such as a revolving platform, hinged dumping arrangement, etc. What appears to be a lid was probably a backstop to shovel against, or perhaps an extension lid to carry the contents away from the track when the car was dumped. The equipment was found in the abandoned workings of a mine 9 miles from Furnace Creek that was formerly worked by Mormons. In the background is the running gear of an old 20-mule-team wagon. The other view shows a wheelbarrow of large capacity that was used to haul away ashes and cinders from the firebox of the boiler at the old Harmony Borax Works. As creosote bushes and mesquite wood served as fuel, the ashes were very light and the Chinese laborers employed in those days were able to handle the barrows fully loaded. Sections of a petrified tree are seen in this picture. They were picked up about 75 miles from Death Valley and are said to be the bole of a prehistoric palm.

EARLY AMERICAN CASTINGS

The ancient Greeks, Romans, and Chinese cast vases, statuary, and other ornamental shapes from iron and bronze more than 2000 years ago. The demand for these articles continued through the ages; and, until comparatively recently, grillwork, statuary, and garden furniture were popular foundry products in the United States. The old print below shows the exterior of a New York shop that specialized in such works of art. At the right is a reproduction of a wood cut that was made in 1849 and pictures the interior of an iron foundry in a locomotive factory. Massive derricks of wood moved the heavier pouring ladles; lighter ones were carried by the workmen.

Bettmann Archive Prints





Modern Cast Iron—A New Engineering Material

J. B. Godshall

POURING A LARGE CASTING IN A GRAY-IRON FOUNDRY

NEW metals are marching across our industrial horizon in profusion, yet cast iron remains one of our stand-bys. Used for six or more centuries, it continues to contribute much to our mode of living, and its place seems secure for as long as we can foresee. Cast iron possesses certain advantages for many applications that make it hard to supplant, especially in view of its comparatively low cost and ease of manufacture. Modern cast iron may be considered a new material because metallurgical research and engineering advances are continually improving its strength and increasing its resistance to corrosion, heat, and wear. They have given us an infinite number of cast irons, each made with a precision impossible of attainment only a short time ago, and each designed to have definite properties for specific purposes.

The American Society for Testing Materials defines cast iron as iron containing so much carbon that, as cast, it is not usefully malleable at any temperature. It usually contains from 1.7 to 4.5 percent carbon and from 1.5 to 2.5 percent silicon. Stated in a more homely fashion, cast iron is a mixture of steel and graphite; but, like all mixtures, the proportions and the arrangement of the constituents can produce an almost unbelievable range of mechanical properties. For example, tensile strengths may vary anywhere from 20,000 to 100,000 pounds per square inch; but in making and machining a given casting it should be recognized that the difficulties grow as the strength of the iron increases.

As is the case with all mixtures, the skill of the operator is of prime importance. Many cooks may use the same recipe or ingredients in baking a cake, but the results are not necessarily the same. Without care and skill on the part of the foundry, all too many castings are likely to compare in quality with the traditional "bride's first biscuits."

Essentially, the production of iron castings involves two operations: Melting a suitable charge under controlled conditions in a furnace from which the iron can be withdrawn, and casting (pouring) the molten metal into a suitable mold substantially conforming to the shape of the desired article. The

Bettman Archive Print

PRIMITIVE IRON FURNACE

Iron was probably used in Egypt, Chaldea, Assyria, and China as long ago as 4000 B.C., and was introduced to Middle Europe before Caesar's time. Homer's writings reveal that iron working was highly developed among the Greeks around 900 B.C. In North America, iron was first produced in 1622 along the James River in Virginia. The first iron castings were made about 1350 in Europe. A crude cupola, forerunner of the modern foundry melting unit, was invented by Rene Reaumur in France back in 1722. Prior to that time, molten metal for castings was provided by some form of blast furnace. This picture shows a primitive type of furnace used in Africa, with hand-operated bellows supplying the blast air required for smelting the ore.

oldest and most economical furnace in use is the cupola, which permits continuous melting. It is charged with alternate layers of coke and pig iron, and limestone usually serves as the flux. Steel scrap in varying amounts is often added as an aid in obtaining certain desirable characteristics. Large quantities of air (about 30,000 cubic feet per ton of metal) are forced through the charge, causing the coke to melt the iron, which is withdrawn from the bottom of the cupola. Other types of furnaces and melting processes are sometimes utilized to obtain certain advantages, such as more accurate control of the composition of the product. The electric furnace is very effective in this respect.

In most cases the metal flows by gravity into a green or dry-sand mold, which must be destroyed in order to obtain the casting. Permanent-mold castings are popular because, as the name implies, the molds can be used over and over. Centrifugal casting, too, is rapidly growing in importance. By this special method the molds are rotated while the metal is being poured, thus forcing it into every recess in the mold. Originally, this process was restricted to cylindrical shapes such as liners, sleeves, etc., which were rotated about a horizontal axis. Recent developments permit intricate shapes to be made with a multiple-mold rotated about a vertical axis. As compared with those produced by other means, centrifugal castings show increased strength, both in tension and cross bending, a more uniform wall thickness, greater soundness, and a closer-grained structure.

Casting processes, generally, are particularly suitable for producing parts with intricate shapes which would be expensive or impractical to manufacture by any other method. The economy effected by them may be a decrease in weight of the finished part rather than in the cost per pound of metal. Consequently, the maximum commercial advantages can be attained only by thorough coöperation between the designer, the foundry, and the metallurgist.

The most common cast iron is gray iron which, as the name implies, has a gray fracture as cast. The combined carbon (or carbon in solution) usually does not exceed 0.8 percent. The remainder of the carbon is uncombined or present as free graphite. Gray iron is readily machinable.

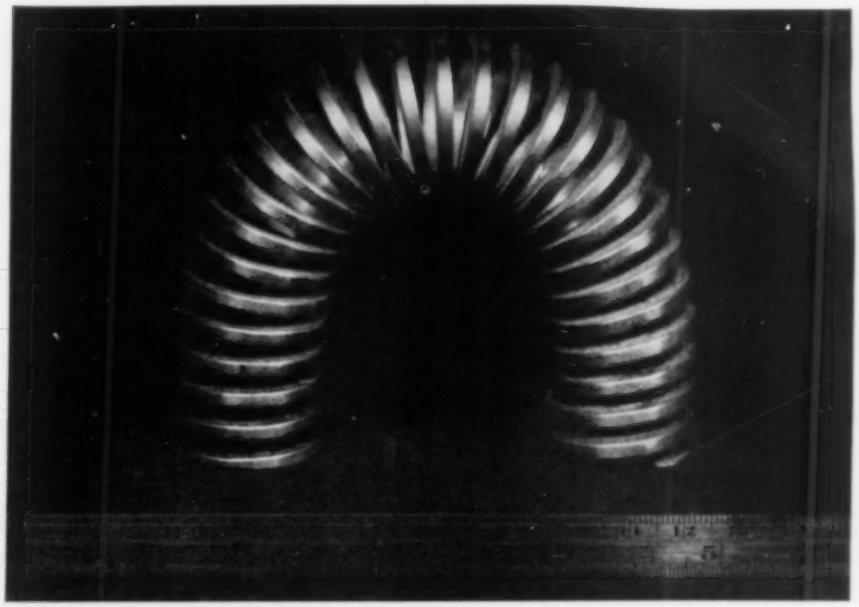
White iron has a white fracture and is difficult to machine because of its hardness. Most of the carbon is in the form of iron carbide. This material is used for such products as plowshares, grinding balls, and plates, where resistance to wear is of the utmost importance. Most white castings are heat-treated to produce malleable cast iron. Mottled iron has a mottled fracture and is a mixture of gray and white iron.

Chilled cast iron is obtained when a desired section or sections of a gray-iron casting are purposely cooled so fast by means of chills that the gray iron is converted into white iron, but only where so treated. The rest of the casting is allowed to cool naturally and forms gray iron. This is a very good practice for certain applications such as chilled rolls; but the same metallurgical result sometimes occurs in gray-iron castings, particularly in thin sections. As a result, the casting is unmachinable and must be either annealed or scrapped.

Semisteel is not a grade of gray iron. Although the literature contains many references to "semisteel," the term is obsolete and its use should be discouraged. If a melting charge of 100 percent steel were practical, the molten metal taken from the cupola would, strictly speaking, still be cast iron.

The chief disadvantage of cast iron is its inherent brittleness, which cannot be

altered materially. This disadvantage is well known, perhaps in certain instances too well known. It must be understood that brittleness, like any other physical characteristic, is relative. Compared with window glass, cast iron is quite tough. The metal is not suitable for uses involving severe thermal or mechanical shock, but the cast-iron spring shown in an accompanying illustration should emphasize the fact that modern cast iron must be considered from a different viewpoint than the prevailing "once over lightly" of the many engineers who are too "brittle-conscious." The spring undoubtedly has no useful life in any service, but it is an interesting proof of a characteristic of cast iron that is rarely recognized or even comprehended.



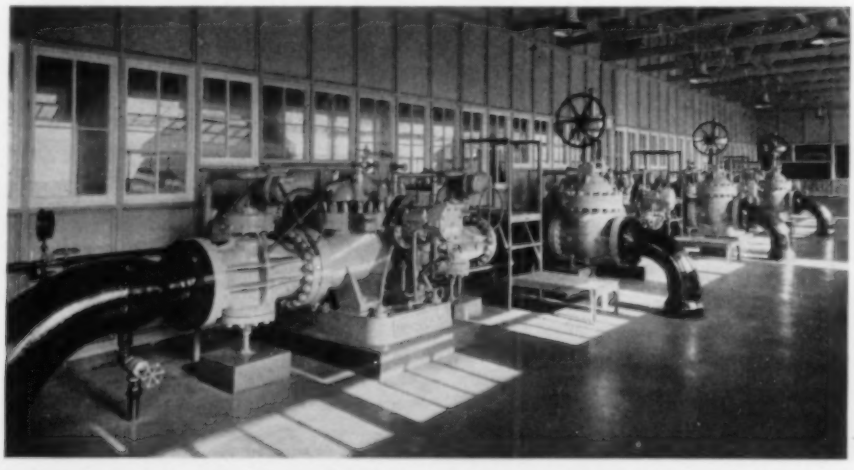
CAST-IRON SPRING

The brittleness of cast iron makes it unsuitable for applications where it will be subjected to severe thermal or mechanical shock. However, brittleness is a relative term, and cast iron is actually tougher than it is commonly supposed to be. To demonstrate this, the spring pictured above was machined from a bar of cast iron. Here is proof that it can be flexed without breaking, although it would soon fail if it were subjected to commercial service.

Nearly everyone is familiar with the notch sensitivity of a stressed piece of steel. Yet relatively few are aware that cast iron, with poor impact properties and almost no ductility as compared with steel, is highly resistant to failure caused by external notches. This is attributed to the countless graphite flakes which serve as individual microscopic notches, tending to distribute the stresses which would cause failure if concentrated at one large notch. Amazingly, in the notched condition, cast iron is generally more resistant to fatigue than steel of the same tensile strength.

Cast iron is very useful in services that involve metal-to-metal wear. Seizing and galling are inhibited by the heterogeneous structure resulting from the presence of a multitude of graphite flakes. It wears well in contact with cast iron, and also with many other alloys. It has a natural tendency to cut very soft alloys, but is not likely to be cut by alloys harder than itself. This characteristic accounts for its wide use in engine cylinders, brake drums, and similar applications where lubrication is imperfect or no lubricant is used.

Cast iron is susceptible to growth (a permanent increase in size) when subjected to repeated cycles of heating and cooling. Growth usually is not serious below 1000°F., but in the presence of certain corroding agents such as superheated steam it may occur at much lower temperatures. Under such conditions the metal becomes brittle and loses most of its strength. However, growth can be retarded by using a dense, low-carbon iron, by avoiding graphitizers, and by adding chromium to stabilize the carbide. Consequently, cast iron that is to be exposed to high temperatures usually contains chromium.

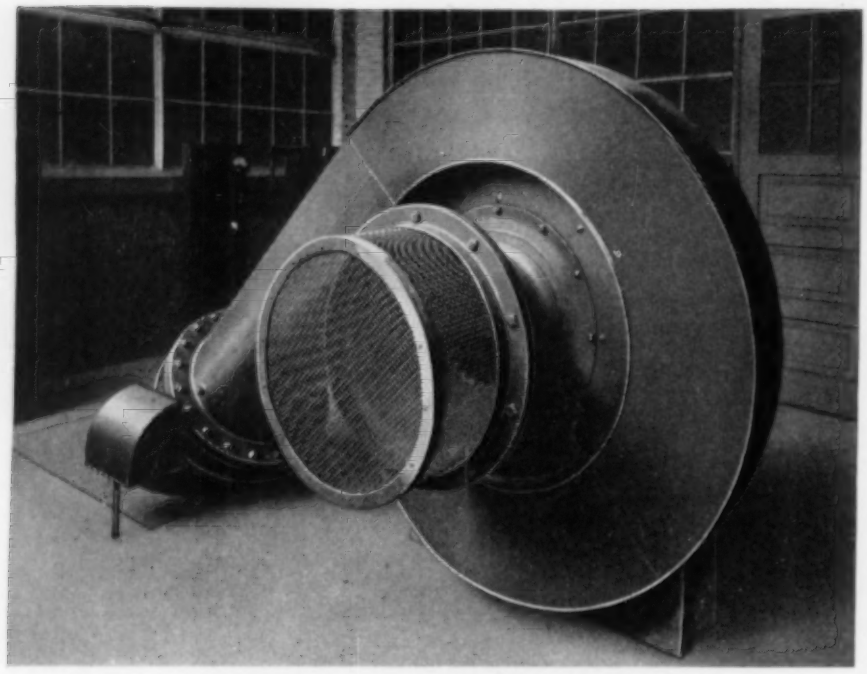


CAST-IRON PUMP CASINGS

Four Ingersoll-Rand centrifugal pumps in one of the stations of the war-born "Little Inch" pipe line that was laid to deliver petroleum products from Texas to the eastern-coast area. Similar pumps are also installed in some stations of the "Big Inch" line, which carries crude oil. Ordinarily, the casings would have been made of steel; but to expedite their manufacture, high-strength cast iron was used and has proved satisfactory in service. The specifications called for iron of a minimum tensile strength of 55,000 pounds. The metal contains 2.8 percent total carbon, 0.8 percent manganese, 2.25 percent silicon, 1 percent nickel, and 0.5 percent molybdenum.

Cast iron is less suitable than steel for welding by the customary methods, but special low-temperature welding processes have been used with some success. Brazing can be done, but in both cases the quality of the work is more dependent upon the skill of the operator than it is in steel welding.

Cast iron has a tendency to graphitize when exposed to corrosive conditions, particularly to salt solutions or dilute acids. While graphitized iron retains the shape of the original part, it is soft and can be cut with a knife, a state in which the metal has virtually no strength. Unfortunately, it is not always possible to predict the exact conditions which will cause cast iron to graphitize. Some historical cases in this connection are extremely interesting. Cast-iron cannon balls, from a warship that had been sunk nearly 300 years before they were salvaged, were natural in appearance but, upon exposure to the atmosphere, became red hot and disintegrated into small pieces. In the case of a cast-iron cannon that was raised after nearly a century in the sea and was found to be typical soft-graphitized



CONTROLLED CUPOLA COMBUSTION AIR

In modern iron foundries it is the practice to proportion with accuracy not only the solid materials that enter the cupola but also the combustion air. The Ingersoll-Rand Motorblower shown here is provided with automatic air-weight control to maintain the desired flow of air for most efficient cupola operation. The machine is designed so that there is a direct relationship between the weight of the air it delivers and the power consumed by its driving motor. Control is effected electrically by operating a blast gate in the intake or discharge line. By means of a small contact-making ammeter, power consumption is held at any desired setting by adjusting the blast gate. The weight of the air delivered per minute is thus held constant despite variations in air temperature, barometric pressure, and cupola resistance.

iron, the gun hardened upon exposure to the air and was subsequently used to fire salutes.

The tensile strength of cast iron is not reduced materially by temperatures up to about 800°F., but beyond that point it decreases rapidly. The use of cast iron at high temperatures has been discouraged by the code of the American Society of Mechanical Engineers, which limits cast iron in unfired pressure vessels to 450° for gases and to 375° for liquids. These codes were established more than 30 years ago when cast iron was much less scientifically controlled and understood than it is today. At that time the metal was little more than a name for an easily cast material made in a cupola. Unfortunately, some engineers are still living in the past—do not recognize the improved quality of modern cast irons. Temperatures up to 650° are now being considered, but for such applications a suitable grade of iron and a special stress-relieving operation are recommended. It is interesting to note that a new subcommittee of the American Society for Testing Materials is investigating cast-iron products that have given good service at much higher temperatures, even above 1000°.

Because of its relatively poor impact properties, cast iron is unsuitable for parts requiring high impact strengths. Its tensile strength is not impaired at temperatures down to minus 75°F., making cast iron satisfactory for purposes where the temperature does not drop below that point and where impact strength is not an important factor. The addition of 3 percent nickel is sometimes specified for low-temperature applications, but the benefits of this practice have not been fully established. By means of a typical quenching and drawing operation, the metal can be hardened to about 400 Brinell to give increased resistance to wear and abrasion. It can also be flame-hardened.

The more important of the alloys that are used commercially with cast iron produce different effects. The percentage of silicon is usually varied, the higher silicons serving for castings with thin sections in order to improve fluidity and to prevent chilling. Various combinations of chromium, molybdenum, and copper up to 1 percent and nickel up to 5 percent are added to improve strength, machinability, and resistance to corrosion, heat, and wear. Small amounts of titanium, aluminum, and zirconium are sometimes used as graphitizers, which improve machinability; and vanadium occasionally serves as a carbide former to increase the wear resistance of heavy or chilled castings.

Cast iron's resistance to corrosion is generally closely related to the specific application. It is used widely in connection with all moderate corrosives and temperatures up to 450°F., higher temperatures being practicable if some chromium is added. Cast iron may be of commercial value even when its service life is very short. In a secret process handling a caustic solution, cast-iron equipment had to be renewed in about one month. That was unsatisfactory. Cast iron containing 3 percent nickel lasted six months, and has been used for years on that basis. The longer service of the nickel-iron cannot be attributed directly to better corrosion resistance, but probably to the improved quality of the castings from a metallurgical and metallographic standpoint.

It is interesting to note that a recent patent covering "high quality cast iron" claims for it a tensile strength up to 82,000 pounds per square inch, as cast, and 105,000 pounds per square inch after treatment for five hours at 700°F. The Brinell hardness at the maximum strength is nearly 400. The iron is low in carbon (about 2.3 percent) high in silicon, and contains up to 4 percent nickel and 1 percent molybdenum.

A few examples of special applications for specific types of modern cast iron show conclusively that they have established excellent records in their field. Brake drums on the new B-29 four-motored bombers and on many other types of aircraft are of centrifugally cast nickel-alloy iron. They are manufactured by a special process in which the iron braking surface is cast in horizontally rotating molds against a preheated steel shell. The resultant bimetal drum combines the toughness, resilience, and strength of the steel support with the resistance to heat, wear, and galling of the alloy cast iron. The alloys are proportioned to yield the optimum combination of strength and wear resistance. Three years of war service, with hardly any failures, are a tribute to the design, production, and materials of these drums.

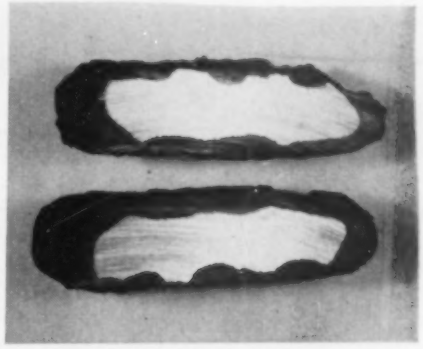
Another low-alloy cast iron—with nickel, chromium, and molybdenum, 250 Brinell, and 65,000 pounds per square inch arbitration-bar tensile strength—is used for engine crankshafts. An 18-ton ingot is required to make a 6-ton forged-steel shaft for a certain 8-cylinder marine diesel engine and two-thirds of the metal must be removed by machining, as compared with only about 10 percent in the case of a cast-iron shaft.

Molds for the glass industry must be inexpensive; easy to machine to a high finish to prevent sticking or fogging; sound and close-grained; resistant to heat, growth, wear, corrosion, contamination, and scaling; and must have low thermal expansion and high thermal conductivity. These exacting requirements can be met by several types of

gray cast irons. The molds may be either chill-cast or sand-cast, depending upon the specific application, which sometimes emphasizes the desirability of a certain characteristic or group of characteristics.

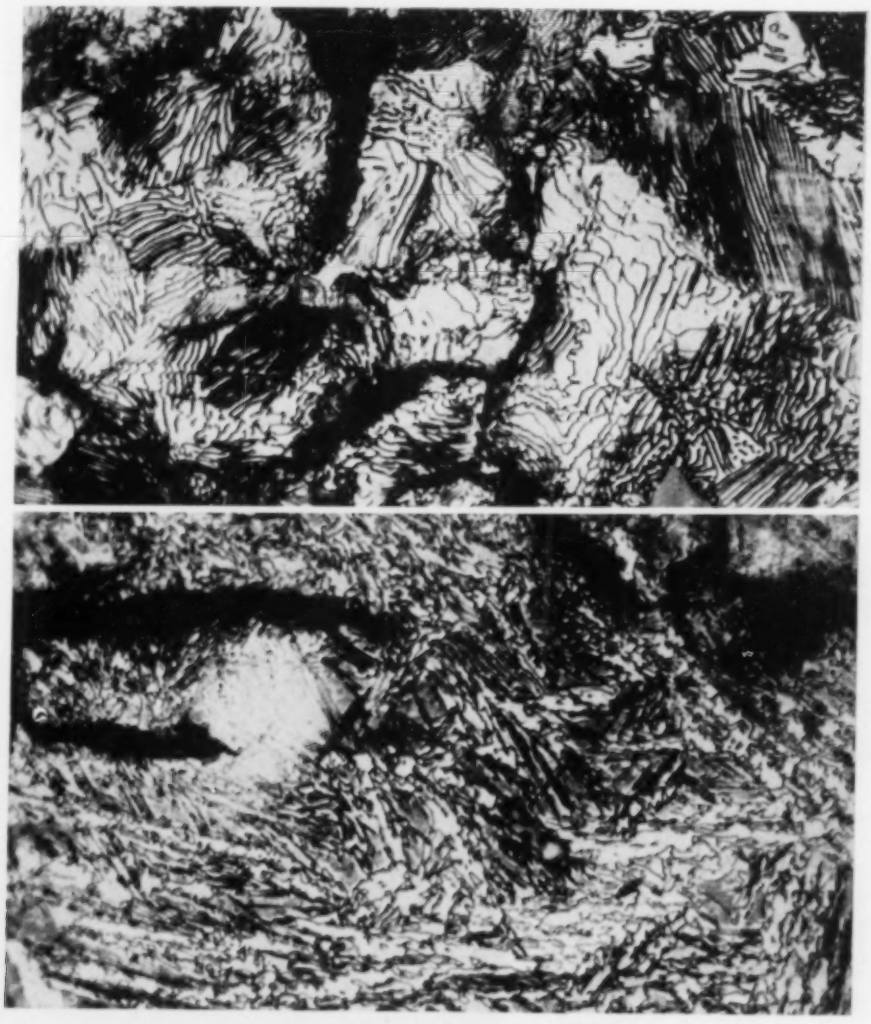
Special types of cast iron have been developed for particular purposes. Iron containing 14 percent silicon withstands wear and abrasion and is very corrosion-resistant. It is suitable for many corrosive chemicals including most acids, excepting hydrofluoric and strong hydrochloric; but it is not recommended for fused-alkali nor for strong hot-alkali solutions. This metal is difficult to pour, and the castings are brittle and commercially unmachinable. Another special wear-resistant iron is "Ni-Hard" which contains about 4.5 percent nickel and 1.5 percent chromium. This material is not very resistant to corrosion, but it has exceptional wear resistance and hardness (550 to 700 Brinell, depending upon whether the product has been sand-cast or chill-cast).

A group of austenitic gray irons is available that is not subject to any perceptible growth, is nonscaling up to 1500°F., and is also characterized by its superior resistance to many of the corrodents usually encountered in industry. The most common member of this group contains about 15 percent nickle, 6 percent copper, and 2 percent chromium. Another member has 36 percent nickel and 3.5 percent chromium, a coefficient of expansion approximately half that of iron or steel, and is especially applicable where resistance to thermal shock is of prime importance. It is apparent that cast iron is worthy of consideration for many uses. It is only necessary to select a grade that is suitable for the service and the design characteristics.



GRAPHITIZATION

Cross section of a cast-iron supporting rib (unpolished and unetched) that was exposed to brackish water. In the dark areas, severe corrosion has reduced the ferrite (iron) content and correspondingly increased the percentage of carbon. The resultant material has practically no strength. The light areas in the center have not been effected.



COMPARISON UNDER THE MICROSCOPE

Photomicrographs of two cast irons, taken at 1500 magnification, to show their differing structural characteristics. The upper one is of a section from a 1¼-inch test bar of a good-grade gray iron having a hardness of 207 Brinell and a tensile strength of 38,400 pounds (ordinary gray iron is around 20,000 pounds). The black irregular streaks are graphite flakes. The lower one shows a section from the center of a 2½-inch test bar of Proferall, a trade-marked high-strength cast iron produced by the Campbell Wyant & Cannon Foundry at Muskegon, Mich., and containing nickel, chromium, and molybdenum. The test bar was attached to a crankshaft cast for an Ingersoll-Rand Type PKVG gas engine. It had a hardness of 321 Brinell and a tensile strength of 87,000 pounds. Black-graphite streaks are visible, as in the case of the other specimen, but they are fewer and more widely distributed because of the lower total carbon content. The fine-grained, acicular structure of this metal is evident.

It would not be appropriate to discuss cast iron without some mention of malleable iron, which has been produced in this country for more than 100 years. As compared with relatively brittle gray iron, malleable iron is very tough. Its Brinell hardness is only 110 to 145, but typical malleable iron will have a tensile strength of 55,000 pounds per square inch, 35,000 yield, 20 to 25 percent elongation in 2 inches, and as high as 25 percent reduction in area. Its corrosion resistance is similar to that of gray iron.

Briefly, the malleabilizing process converts hard, brittle, white-iron castings of pearlite and cementite into malleabilized iron consisting of two soft constituents, ferrite and temper carbon. This change is effected by a suitable heat treatment, which is essentially a relatively long and carefully controlled annealing operation. There is no ferrous product of comparable mechanical properties that machines so easily. Malleable iron's durability, rigidity, and power to resist shock, together with its excellent machinability, make its use almost universal in many industries and frequent in all industries. It serves widely for the making of tools, implements, hardware, toys, chains, fittings, covers, stoves, and countless other commodities.

Research has brought about great improvements in iron castings. Continued research, coupled with a fuller understanding of the many advantages cast and malleable irons offer in their fields of application, will inevitably still further increase the usefulness of this remarkable material.

COMPRESSED AIR A

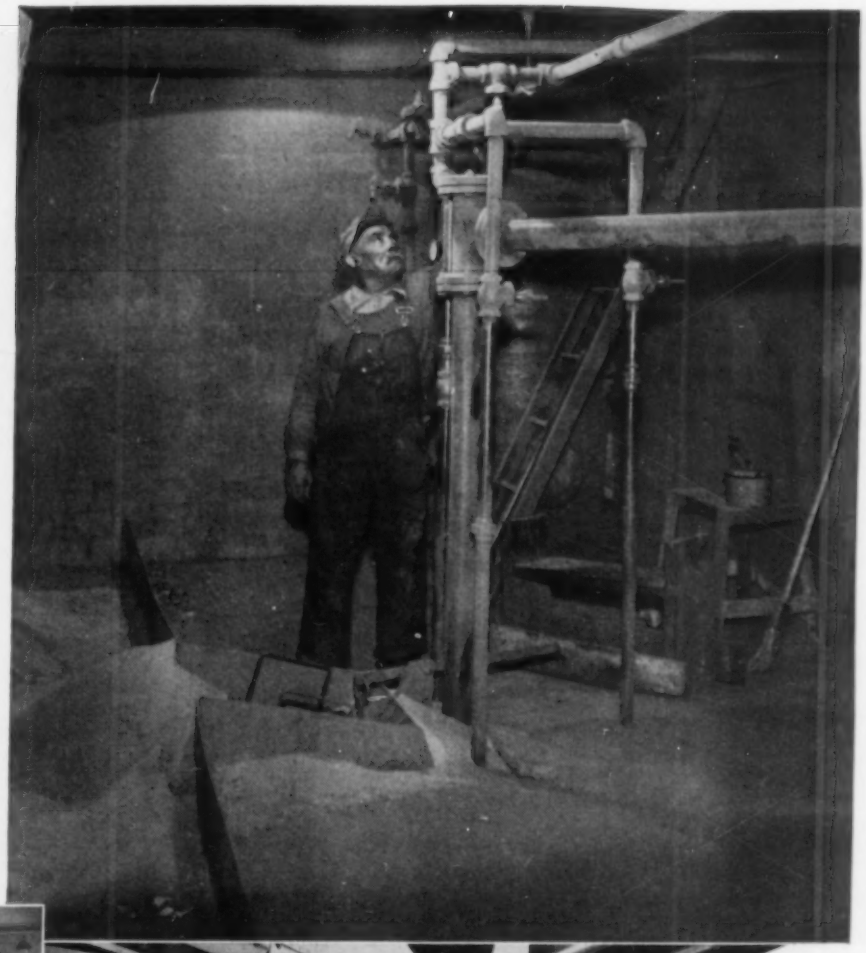
THE picture below shows two British sappers using compressed air to unearth a Teller land mine planted by the Germans. The Teller is a large disk-shaped antitank mine weighing 19 pounds and containing 11 pounds of the high explosive TNT. The compressed-air method of detecting enemy land mines is reported to have been introduced on November 18, 1944, by Lieut. W. Campbell of the 15th Scots Division of the Royal Engineers. During the morning of its trial, 92 Teller mines and several dozen other types were removed without mishap. Compressed air under about 50 pounds pressure is blown through ½-inch tubing of such length that the operators can keep at a safe distance. The force of the air removes the earth covering the mine and exposes it to view.

THE air-operated machine shown at the right saves time in making tension tests of wire cables. Mechanisms formerly used for the purpose took one cable at a time, whereas this one can test four lines each of which may be made up of short lengths up to 52 in number. A double-acting pneumatic cylinder is mounted at one end of the table and a weighing scale at the other. The two are first connected by a cable slightly larger in diameter than the combined girth of those to be tested. Compressed air is admitted to the cylinder, and when the pulling effort for which the scale has been set is reached, the operator sets a regulating valve on the air line so as to maintain that pull. He then releases the pressure, removes the heavy cable, and substitutes those that are to be tested. When the air is turned on again it automatically exerts the pull previously made. A time switch holds the cables under tension for the period desired and then releases the pressure. The apparatus is made by the Jacoel Cable Splicing Equipment Company of Buffalo, N. Y., and is designated as a proof-loading machine. One of its chief uses is for proof-testing aircraft control cables. The maximum tension obtainable with the standard unit is 11,000 pounds, but special machines are built to meet any specifications. Compressed air is supplied at 100 pounds pressure and subsequently reduced to the pressure desired.

R AT WORK

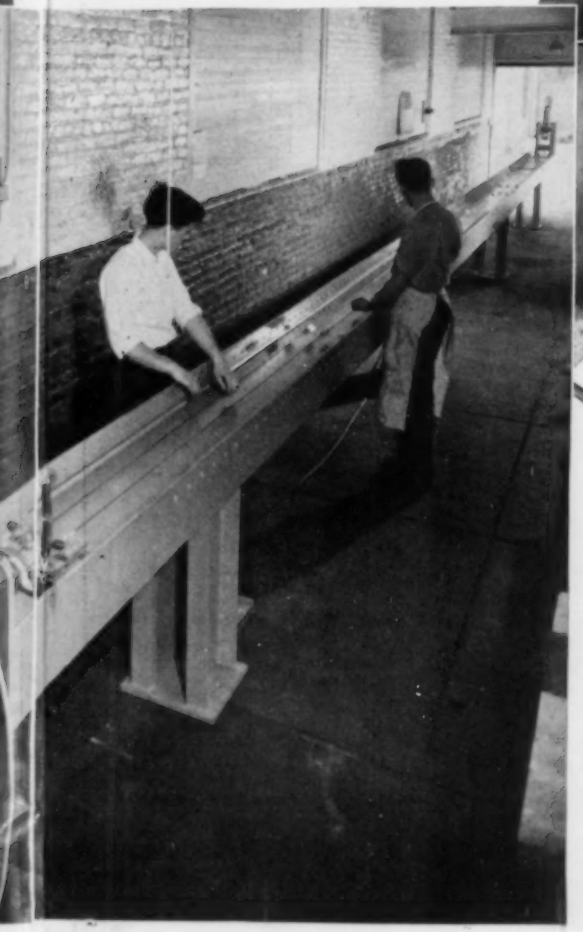
ALL sorts of industries make use of compressed air. In the Fuller Cleaning & Dyeing Company's establishment at Cleveland, Ohio, the fur on garments that have been dry cleaned is fluffed up with an air blowgun (left) before delivery to the customer.

(Photo Compressed Air Institute)



WITH the aid of compressed air, this 75-year-old veteran employee (right) of the New York Central System at Cleveland, Ohio, keeps hundreds of the line's locomotives supplied with sand for use under their wheels. Compressed air, at 75 pounds pressure, blows the sand from pits beneath the floor through a pipe line to an outside tipple, where the locomotives take on their load. The sand is dried and conditioned before going to the storage bins.

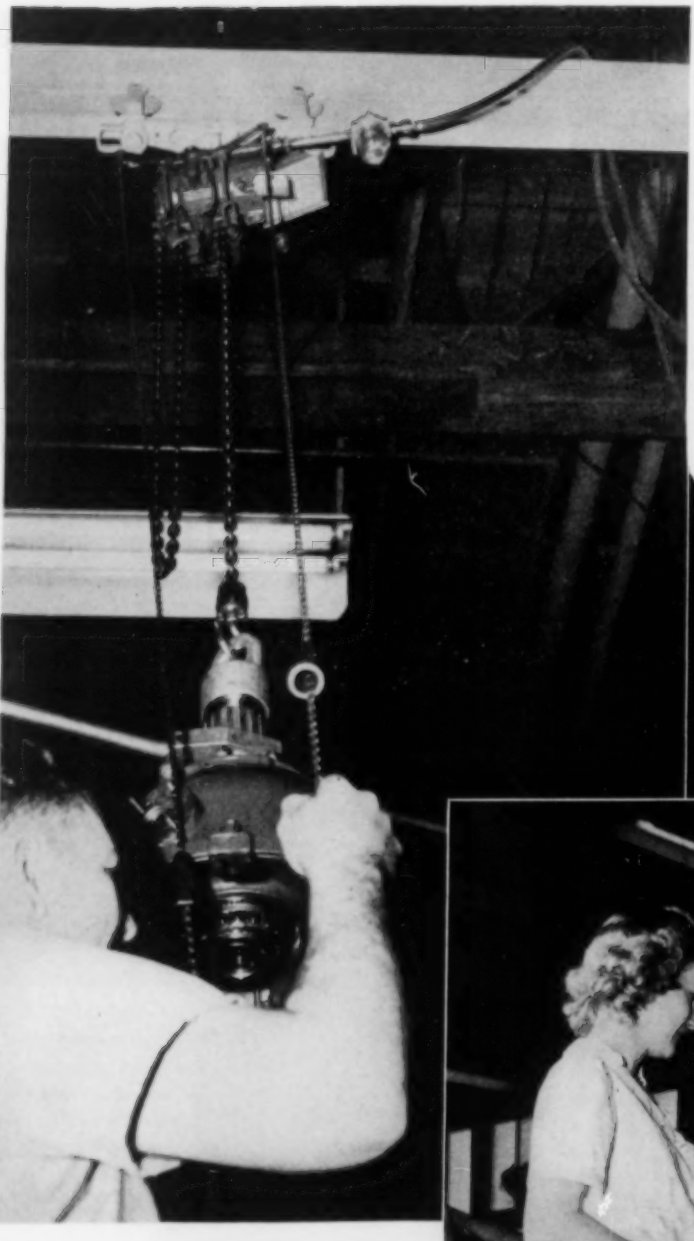
(Photo Compressed Air Institute)

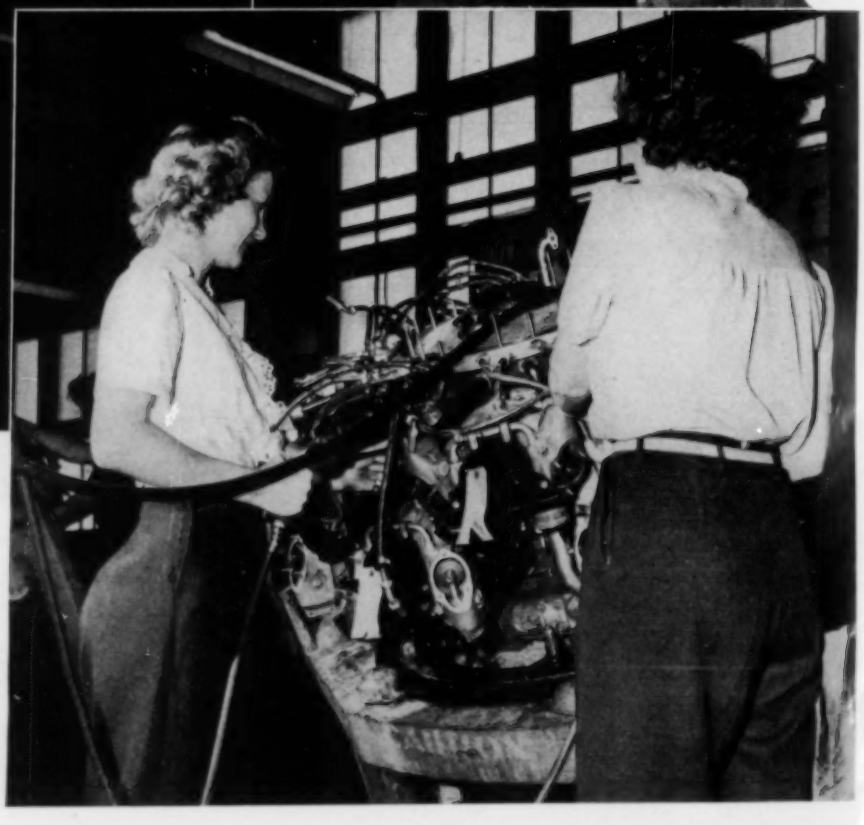


NORMALLY, compressed air is piped to points of use, but shown above is an instance where it is transported in a container, as one would carry a bucket of water. This Handi-Air reservoir was developed by Scott Aviation Corporation of Lancaster, Pa., for on-the-spot inflation of airplane tires. Its use sometimes obviates the jockeying of a plane to a point within reach of an air hose. The tank weighs 24 pounds and is filled from a regular air-distribution system. It can be charged to a pressure of 125 pounds. One tankful will inflate eight light airplane tires.

Air Power Speeds Repair of Bomber Engines

Air Technical Service Command photos



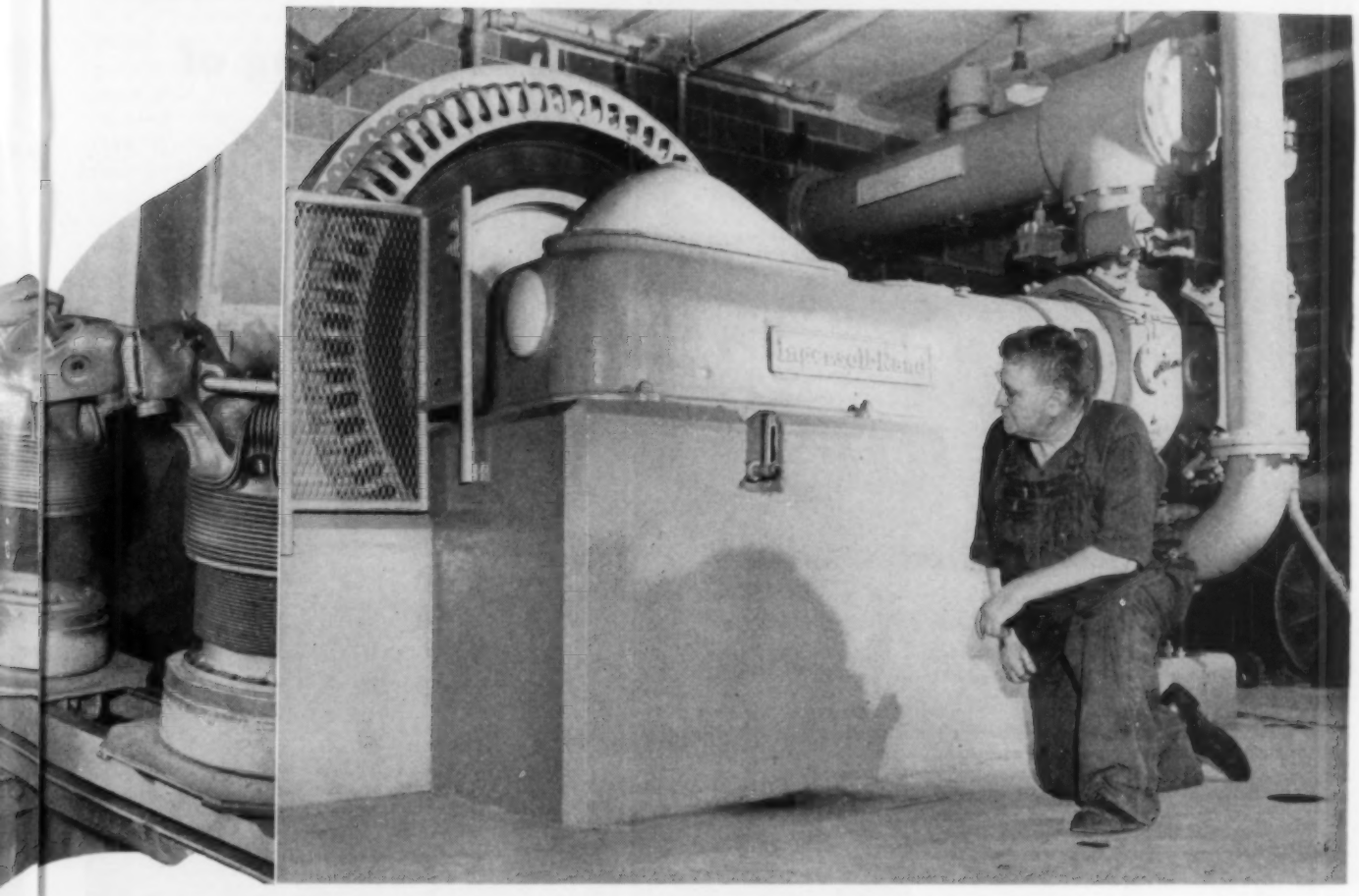


TYPICAL USES OF AIR

Throughout the engine-overhaul shop, air-powered hoists such as the one shown above lift the heavier parts during dismantling and reassembling. Air wrenches (right) lighten the labor and speed the work of tearing down and building up engines. Largely because of the use of pneumatic tools, many of the operations can be performed by women. Engine cylinders are quickly given a protective coat of paint with air-spray guns (top-center).

NEW AIR COMPRESSOR

One of two 1420-cfm. air compressors recently added to the shops to furnish air for cleaning engine parts by pressure blasting.



AIR power plays a big part in the work of overhauling aircraft engines in the shops of the Fairfield Air Technical Service Command at Patterson Field near Dayton, Ohio. In fact, one foreman has estimated that, without the aid of pneumatic wrenches, not more than one-third the past daily throughput of between 50 and 60 Pratt & Whitney 14-cylinder, radial-type engines would have been possible. The shops constitute one of twelve primary supply and maintenance components of the Air Technical Service Command in this country and are responsible for aircraft maintenance within an 8-state area.

There are more than 3 miles of compressed-air delivery lines just in the engine-overhaul shop, which covers an area equivalent to a large city block. The air is used to operate pratically all the power machinery and equipment utilized in dismantling and reassembling the engines from B-24 Liberator bombers and C-47 transports.

Typical industrial assembly-line practices have put the overhaul shop on a mass-production basis. There are two main lines, one for tearing down the engines and the other for putting them together again. Each engine enters the building at one end of the disassembly line, and by the time it has traveled its entire length of 276 feet it has been reduced to a mass of nuts and bolts and parts. All these are then routed through various cleaning, inspection, and rework departments and finally reach the assembly line, where they are fitted together to form the same engine from which they were removed originally. It takes approximately six days to complete the overhaul, which provides an engine capable of flying the same number of hours as it did when it was new.

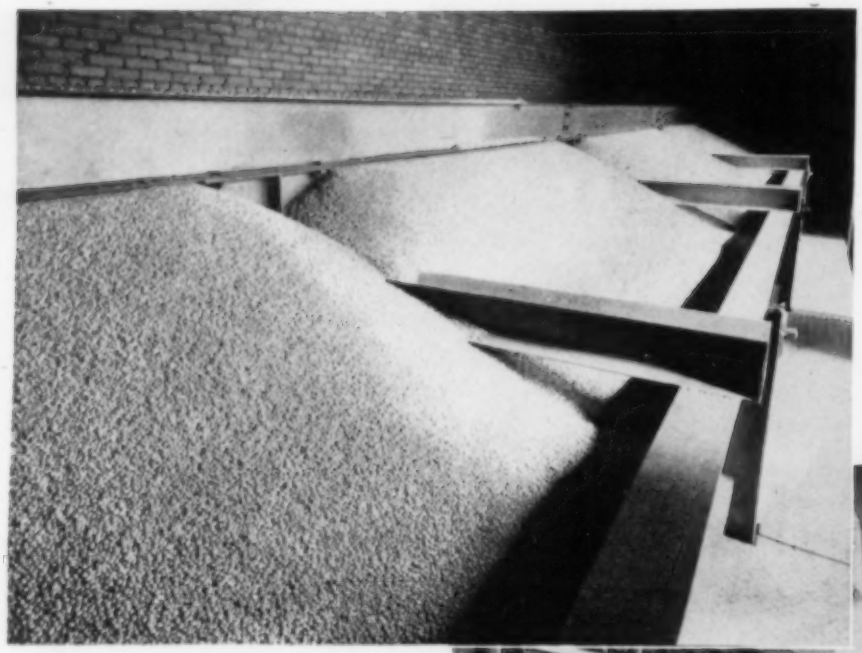
A tour of the shop reveals the widespread employment of pneumatic machinery. An air tool of some kind is used at virtually every step of the dismantling and reassembling operations. The greatest volume of air is consumed, however, in the cylinder sand- and seed-blasting department, where newly installed equipment automatically cleans one cylinder a minute with walnut-shell particles that are shot through a series of nozzles under 100 pounds pressure. Similar equipment cleans two pistons every minute.

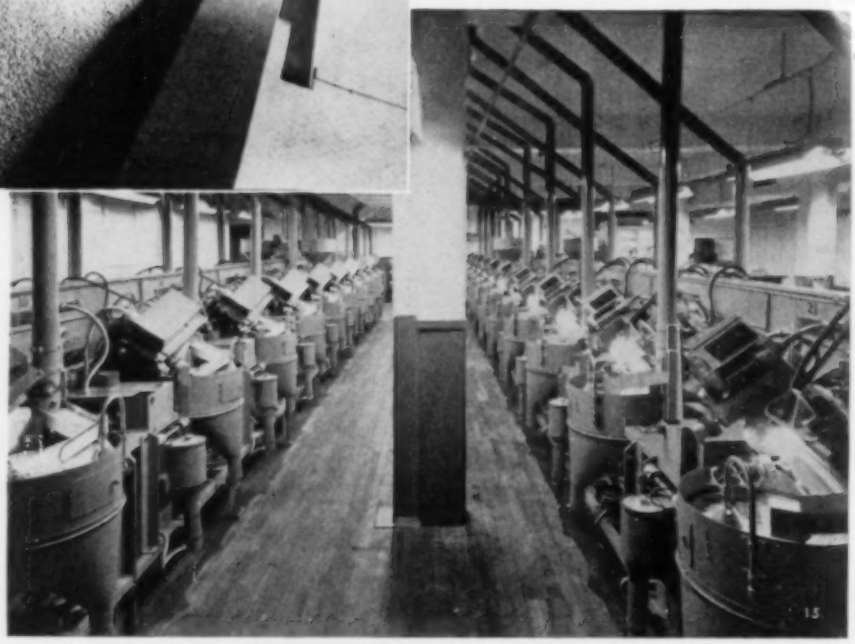
Before the addition of the blasting apparatus the shop air was supplied by four compressors, each with an output of 390 cfm. But with the consequent increase in air consumption, two new Ingersoll-Rand machines, each delivering 1420 cfm., were set up. These units provide air exclusively for the cylinder-cleaning department, while the four smaller compressors carry the remainder of the shop load. Pressures range from 80 to 100 pounds per square inch, at least 90 pounds being required for the sand- and seed-blasting machines.

The aim of the shop, and of others under ATSC direction, is to utilize manpower as efficiently as possible, and one of the greatest contributing factors towards this end is the increasing use of compressed air. New ways are continually being found to save labor by employing air power to advantage, as a recent case strikingly illustrates. Packing and pack nuts were being placed by hand on the push-rod housings of engines, and the services of two women were needed to keep pace with the other work along the assembly line. Two veteran male employees thought the method could be improved upon and, in their spare time, devised an air-operated press that could be built from surplus materials obtained in the salvage yard. Using a condemned airplane-engine cylinder, they constructed a press by means of which the parts can be put on the housings in half the time formerly required and with only one woman operator. The men received a cash award for their display of ingenuity.

Photoelectric Sorting of Foods

Anna M. Hoffmann





SORTING foodstuffs such as beans, peas, corn, peanuts, coffee, lemons, and the like by hand is as outmoded today as is driving around in a buggy, for neither keeps pace with the fast-moving tide of the times. In this work of preparing products for the market as it is now done by equipment developed by the Electric Sorting Machine Company we have another example of the wonders that are being achieved through the medium of the electric eye, which takes the place of the human eye, but with this difference. Where the latter gets tired and therefore cannot always be counted upon to cull the good from the bad or undesirable, the former rejects everything that should be segregated from the ceaseless stream fed through the equipment.

It has taken more than nine years of experimenting and several years of actual and varied use to bring photoelectric sorting to the commercially practicable stage. Color is the basis upon which the processing is done, and because the foodstuffs handled differ appreciably in this respect, two types of machines have been designed: the "dark-trip" and the "bichromatic." The first-named is sensitive to dark or light objects and can be adjusted to discard 10, 25, or 100 percent of peanuts, for example, in various stages of discoloration as they are brought, one by one, in front of the photoelectric scanning mechanism. There each is viewed from both sides at the same time, and if either side shows up dark, that particular nut is rejected—is automatically separated from those that meet the requirements as imposed by the operator. Besides peanuts, both raw and blanched, this unit is suitable for sorting different kinds of beans, peas, and corn.

PICK THE BAD FROM THE GOOD

Some of the 80 photoelectric sorting machines in the plant of the Michigan Bean Company, Inc. The installation is designed to separate Michigan type pea beans and can handle 192,000 pounds in a 24-hour day. The vacuum wheel of each unit by which the beans are picked up individually for examination and acceptance or rejection makes 107 rpm., giving each machine a capacity of about 100 pounds an hour. With the exception of emptying the receptacles in which the discards are collected, the operation of sorting is automatic and continuous. The good beans fall on a belt conveyor which carries them to storage bins.

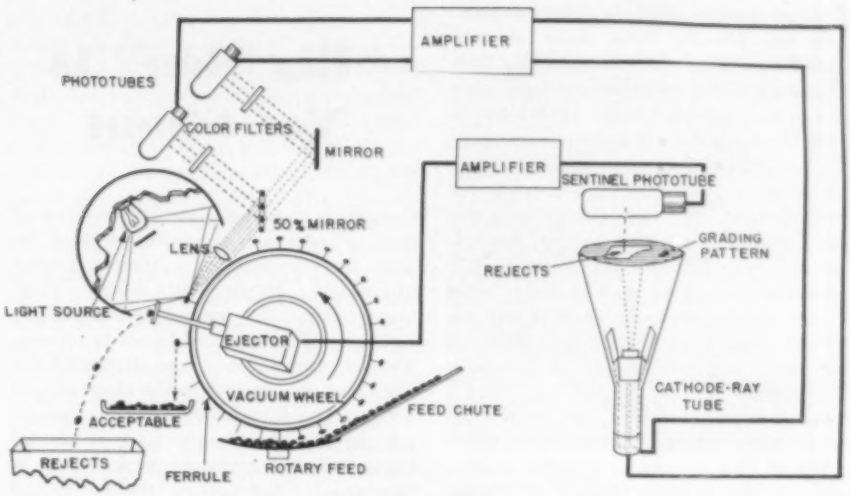
The bichromatic machine does more than differentiate between light and dark objects. It is sensitive to all shades of a color and can be set to select a given color or a number of colors from either end of the spectrum. In the case of lemons, for instance, it is possible to segregate light greens, dark greens, silvers, light yellows, and dark yellows, all in one handling and without human hands touching the fruit the while. Sorting coffee beans is based on the same bichromatic principle.

To give the reader an idea how the work proceeds, we will follow a Navy bean, with the aid of the accompanying diagram, through the machine. As it travels down a feed chute, it is picked up and held by a small cylindrical ferrule on which a vacuum of 1¾ pounds is pulled. This ferrule, with numerous others, is attached to the periphery of a wheel, which turns continuously. At a definite point in its circuit, an incandescent lamp illuminates the bean which, by the aid of mirrors and color filters, reflects a measure of the light toward two photoelectric tubes, one sensitive to red light and the other to green. It is the percentage of red and green light thus reflected that determines the course of the bean from there on. The filters, which are interposed between the mirrors and the phototubes, vary in color with the commodity that is to be handled and are chosen for the purpose of transmitting the particular wave lengths that will assure maximum dis-

tinctionbetween good and bad foodstuffs.

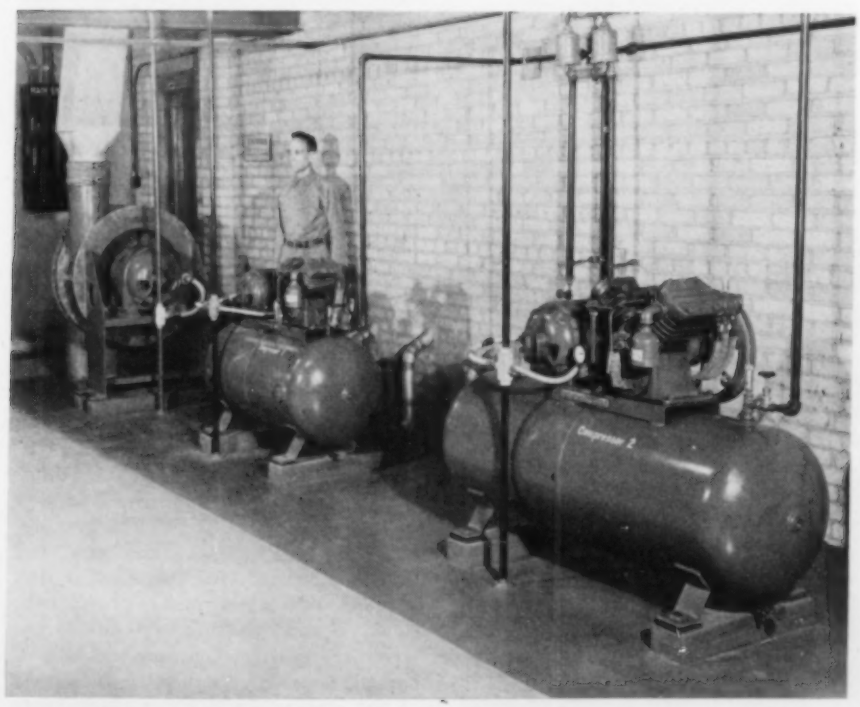
The output of each electric eye is fed into dual-channel amplifiers and thence to a cathode-ray tube whose beam is deflected vertically and horizontally in proportion to the percentage of red and green light picked up by the electric eye. One part of the screen of the cathode-ray tube is masked, and when the beam falls on that section the coffee bean is acceptable. But if the beam is directed toward the unmasked area, then the bean is of a quality that is not acceptable. In that case the cathode-tube ray shines on a "sentinel" phototube which, through the medium of a relay, actuates a solenoid ejector that constitutes a part of the sorting machine and that operates at the rate of sixty-three 5/8-inch strokes per second, with complete damping after each stroke.

After the bean has been examined, the vacuum is broken, thus releasing it from the ferrule and causing it to drop. If it is a good one, it falls on a traveling conveyor which carries it to a storage bin; if it is a rejected one, the ejector comes into action and pushes the ferrule outward from the rim of the vacuum wheel so that the bean falls into the receptacle for discards. All the while this is going on, the vacuum wheel is turning; but before the ferrule picks up another bean from the stream descending the feed chute, a ¼-inch-wide jet of compressed air at 150 pounds pressure is blown through it in order to clear the orifice of any chips or skins that may have clogged it and that might prevent the ferrule from being loaded during its next revolution.



WORKING DIAGRAM

The entire process is automatic and continuous, the equipment being set at the start by the designers for the degree of separation desired by the user. Each is built, of course, in accordance with the nature of the product that is to be handled by it and with plant requirements; but other than that, the actual method of sorting by both types of machines is essentially the same as just outlined in the case of the Navy bean. It is reported that thousands of pounds of varying foodstuffs are being separated daily by the photoelectric process with well-nigh incredible speed and accuracy.



MOTORBLOWER AND COMPRESSORS

The equipment that supplies the vacuum and the compressed air required to operate the photoelectric sorting machines of the Michigan Bean Company. Suction is induced by a 2-stage Ingersoll-Rand Type G Motorblower with a capacity of 4000 cfm (left). The two 1½-hp. Type 30 compressors provide the air by which bits of skin and chips are removed from each ferrule on the vacuum wheel preparatory to again pulling a suction on it and reloading.

Synthetic-Rubber Airfoam

CUSHIONS of aerated latex for railway, automobile, and other seats are nothing new and were coming into general use before the war. The product, known as Airfoam, was introduced by the Goodyear Tire & Rubber Company and was made of natural rubber. When that material became scarce, the company turned to synthetic rubber and has succeeded in making Airfoam that is said to be superior to the original product in "flex" life, aging characteristics, and oil resistance.

Extensive laboratory tests, reports the manufacturer, proved that the new whipped latex lost no resiliency after being compressed to half its normal thickness 250,000 times at the rate of once a second; and at the end of a 30-day aging test in a Geer oven at 158°F. it remained substantially unchanged. By still another test, a section of the material was placed in an "air bomb" where it was subjected to a temperature of 260° and compressed air at 60 pounds pressure. Even then there was no indication of a change in form or any tendency to become hard, soft, or tacky.

Airfoam cushions can be made of any shape or thickness, and the compression or load-carrying capacity can be varied by controlling the amount of air combined with the latex during the mechanical foaming process, thus giving the product any desired hardness within a fairly wide range. Except for the plywood or metal-sheeting foundation, no springs or other type of support is required. The War Production Board has recently released restrictions on the use of the new material.

"Big Ben" is *Not* Silent

IN an article, *Bells of Many Lands*, in our March, 1945, issue, it was stated that England's famous Big Ben in the tower of the Parliament Buildings in London has not been used since a crack developed in it a few years after it was hung. Readers in England have informed us that this statement is incorrect; that Big Ben booms out the time regularly on the British Broadcasting Company programs. We regret the error and make due amends. One of our correspondents backed up his protest with a pamphlet, *The Story of Big Ben and the Great Westminster Clock*, issued jointly by the BBC and a government department, and from it we have extracted the following facts:

When the architect, Charles Barry, laid out the present Houses of Parliament Buildings he included a clock tower, and in 1844 Parliament commissioned him to place a timepiece there. Barry instructed his friend, Benjamin Lewis Vulliamy, the queen's watchmaker, to prepare a design. The clock that was to be became the subject of much oratory in Parliament, and the sentiments expressed were summed up by the Chief Lord of the Woods and Forests, who promised that it would be "a noble clock, indeed a King of Clocks, the biggest and best in the world, within sight and sound of the heart of London."

Vulliamy prepared his design, but nothing more was done, and after a lapse of two years the Clockmaker's Company declared that the making of such a national timepiece should be open for competition. After a heated discussion, Parliament asked Prof. George Airy, the Astronomer-Royal, to write specifications and to act as referee. Two of Airy's conditions staggered the clockmakers: first, that the clock should register the time correct to one second per day; and, second, that it should twice daily telegraph its performance to Greenwich Observatory where a record would be kept. No public clock, controlling a heavy striking mechanism and driving long hands exposed to wind and weather, had ever worked within such narrow limits. The trade said it was impossible and asked that the conditions be modified, but the Astronomer-Royal was adamant. He said that the King of Clocks must be the Prince of Timekeepers.

For five years a deadlock existed, and then Airy called in Edmund Beckett Denison to act as coreferee. Among other things, Denison—later Sir Edmund Beckett—was an authority on clocks, watches, and bells. He declared that such a clock could be built and produced his own design for it. He turned its execution over to E. J. Dent, a highly skilled chronometer maker. The latter began work on it in 1852, but died the following year with the timepiece unfinished. After some delay, his stepson Frederick, who had taken over the business, undertook to complete it, and did so a year later.

But the tower was not ready to receive the clock, and for five years the movement was kept on test in Dent's factory, during which time Denison invented his now famous Grimthorpe gravity escapement which has been included in almost all public clocks built since then. A 14-ton hour bell had been specified but no arrangements made for its production. A bell of that size had never been produced in England, but Messrs. Warner of London took a contract to cast it and four quarter bells. When the hour bell was delivered it was much too thick in the waist and 2 tons overweight. At Westminster, it was hung from a huge cat-gallows in the palace yard and struck with a hammer to bring out the tone. The tone was not good, so a larger hammer was tried. It brought out the tone, but also cracked the bell.

Another bell founder, George Mears, recast the bell, which then was close to the specified weight. It was shipped to Westminster and welcomed by the shouts of a great crowd gathered there. The bells were hoisted into the belfry, and the clock was assembled and fitted, but it would not run. It was found that the cast-iron hands, weighing 2½ tons, were too heavy—the clock could not move them. A set weighing half as much was made of gunmetal, and while the hour hands were satisfactory the minute hands had too much "shake." New minute hands of copper, hollow and with interior supporting webbing, were obtained, and even though 14 feet long they weighed less than 200 pounds each. Upon trial they worked well, and the great timepiece began its service on May 31, 1859.

Then there ensued in Parliament a debate over the naming of the bell. The Chief Lord of the Woods and Forests, Sir. Benjamin Hall, a huge man who was called "Big Ben," made a long speech. As he sat down a member shouted in jest: "Why not call him 'Big Ben' and have done with it?" The suggestion prevailed, and the clock has been "Big Ben" ever since. After two months' use, a crack developed in the hour bell. Removal and recasting were almost impossible, so the mechanism was altered and the hours were struck on the largest of the quarter bells. For three years London had to endure what the pamphlet calls "this miserable expedient." Then the hour bell was turned slightly, a much lighter hammer provided, and it went back into service.

Big Ben's first broadcast was on

Ewing Galloway Photo

WORLD'S MOST FAMOUS CLOCK TOWER

Big Ben, the Houses of Parliament Buildings, and Westminster Bridge across the Thames River, as they appeared before the war. Although the tower and clock escaped bombing, the House of Commons was badly damaged and is now being demolished preparatory to constructing a new building.

December 31, 1923. Transmissions over the air are direct, there being a microphone hung just above the bell. Pressure of a switch in Broadcasting House, the BBC studios, brings it into action whenever desired. On home programs Big Ben is heard twice daily, at 7 a.m. and 9 p.m., but for overseas broadcasts it is rung as many as 43 times a day and has therefore been called "the signature tune of the British Empire." From September, 1939, until November 11, 1940, Big Ben was "off the air," its place being taken by the Greenwich time signal. The bell was reinstated, at the request of religious leaders, "as a signal calling freedom-loving peoples to one minute's reflection, silence, and prayer." From June 17, 1944, to September 8 of that year a phonograph record substituted for reasons of security.

The clock itself is the largest mechanical timekeeper in the world. It weighs 5 tons, but some individual parts are as light as those of a high-grade watch. It is driven by weights that descend almost to ground level when it is run down. Two strong men formerly spent eight hours twice a week winding it, but since 1913 that chore has been done electrically. The pendulum is 13 feet long, weighs 685 pounds, and makes a complete swing every two seconds. The four dials, of opalescent glass, are each 22½ feet in diameter and the hour figures are 2 feet high. The points of the minute hands cover 100 miles in a year's travel.

One of our readers from whom we heard in connection with our misstatement about Big Ben is T. R. Robinson, a member of the British Horological Institute, who has written numerous articles on bells and clocks. Included in his letter was this paragraph: "Your contributor seems to have missed the connection between bells and compressed air. In practically all modern carillons, a number of which are erected in the United States, the automatic tune-playing mechanism and the player keyboard—which resembles the keyboard of a piano—operate the hammers through electro-pneumatic mechanism. The firm of Gillett & Johnston, Ltd., whose works are near my home, made the carillons for Riverside Drive Church, New York; the University of Chicago; the Mayo Clinic at Rochester, Minn.; Princeton University; and Grace Church, Plainfield, N. J., and to the best of my belief, all of these are operated by such electro-pneumatic gear."

"LUBRIKART"

Pushed like a perambulator and only 21 inches wide, this carrier is a lubricating department in itself. It is a recent product of the Alemite Division of the Stewart-Warner Corporation and is one of two models that have been designed to transport and to dispense a variety of lubricants in industrial plants. The unit shown mounts two 7-gallon tanks with low-pressure pumps, hose, and nondrip nozzles for filling gear housings and oil reservoirs on machines or hydraulic systems; another 7-gallon container with a high-pressure pump for loading handguns; two 1¾-gallon tanks with pumps for filling oil cans; six spout-type oil cans which are set in racks on each side; and four lever-type handguns which are carried in a base compartment at the rear. There is also space for waste, replacement fittings, small tools, etc. In addition to all this, the other model is equipped with a high-pressure, hand-operated grease pump that holds 30 pounds and develops a maximum pressure of 7000 pounds per square inch.

Mercury-Vapor Detector

HEALTH MEASURE

This instrument detects the presence of mercury-vapor concentrations in air as low as 1 part in one billion by volume and gives continuous reading. To be safe, the atmosphere should not contain more than 1.2 parts in 100 million, which is the toxic limit.

THERE are numerous industries in which workers are exposed to the harmful effects of mercury-vapor concentrations in the air. This necessitates keeping a continual check on the atmosphere to make sure that the concentrations remain below the toxic limit, which is 1.2 parts mercury vapor in 100 million parts of air by volume. General Electric Company has recently developed a new detector of the electronic type which instantaneously measures concentrations as high as one part in three million parts by volume and as low as one part in 200 million with an accuracy of approximately 5 percent. When set at its highest point of sensitivity, the instrument can record, with reasonable accuracy, concentrations as low as one part in a billion.

The detector is housed in a portable steel case on the front of which are a line voltmeter, a microammeter, rheostat adjusting knobs, and switches. It operates on 115-volt, 60-cycle power and takes in air at the rate of ¼ to ½ cfm. through a cylindrical absorption chamber inside of it. The latter contains a phototube and an ultraviolet lamp which ordinarily permits normal current to flow through the tube. However, the presence of mercury vapor in the air drawn into the chamber intercepts and scatters the ultraviolet light, thus reducing the phototube current. This drop is measured by means of a bridge circuit and indicated on the microammeter, thus giving instant reading at all times of the state of the atmosphere. The detector is especially designed for use in mines; in glass, chemical, and smelting plants; and in the manufacture of electric apparatus where workers are exposed to mercury-vapor concentrations.

This and That

Railroad Tunnel Opened

After 30 months of construction, a 3015-foot tunnel through Bozeman Pass, near Livingston, Mont., was opened to traffic by the Northern Pacific Railway on July 28. It replaces a bore that had been in service since 1884. Two Chinese railroad officials, who are in the United States with 1500 of their countrymen to spend a year learning our railroad methods, held a ribbon that was broken by the first train to go through.

★ ★ ★

Montanans Note Gold Discovery

On July 14, a group of Montana mining men observed the eighty-first anniversary of the discovery of gold in their state. The strike was made on July 14, 1864, in Last Chance Gulch, near Helena, by a party of prospectors that had left Alder Gulch, present site of Virginia City, during the previous spring. Their original goal had been the Kootenai, in what is now northwestern Montana, where it was rumored that gold had been found. Before they had gone far, they met a party returning from the Kootenai with discouraging news, so they elected to prospect the Little Blackfoot River Valley. Finding nothing there and having enough "grub" to continue the search, they kept going and eventually came to Prickly Pear Valley in the headwaters of the Missouri. Their first efforts in Last Chance Gulch, a Missouri tributary, were unsuccessful, so they traveled northward; but after six or eight weeks they returned to the scene of their previous efforts. This time they were rewarded with rich gravel, and Montana's mining boom was born.

This year's celebration was at Marysville, north of Helena, where the Drumlummon Mine is located. This property was discovered in 1876 by Col. Thomas Cruse, who had followed the rush from Alder Gulch to the Helena section. By "postholing" he discovered lode ore a few hundred feet above the stream where placer mining had already been abandoned. At first he worked alone, using a Spanish *arrastra* to crush his ore. Later he built a 5-stamp mill and employed six men. After 29 months of effort, he sold bullion, consisting of two-thirds silver and one-third gold, for $144,538. At a depth of 100 feet the vein was 82 feet wide. The mine was sold to the Montana Company of London in 1882, and the new owners erected a 60-stamp mill, to which a cyanidation unit was added. The mine produced steadily until 25 years ago. Since that time it has been operated principally by leasers. In 1941, W. R. Wade and R. H. Rheem took over the property and constructed a 150-ton amalgamation-flotation mill. Their activities were suspended by the Government order of 1942 halting work in gold mines, but plans are now being made to resume them. The Drumlummon Mine is credited with a production of around $30,000,000.

★ ★ ★

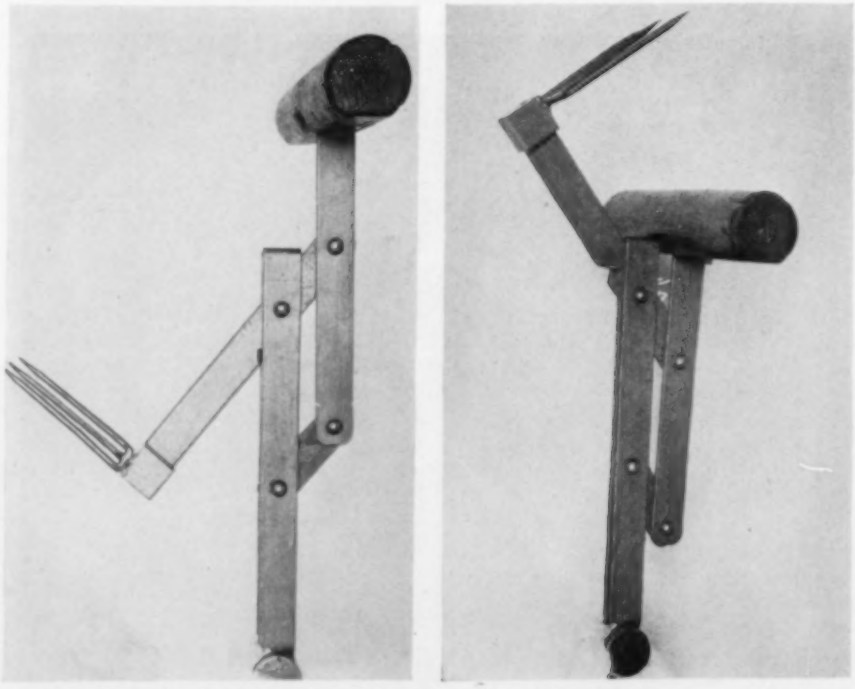
Drilling Teeth With Air

Dr. Robert B. Black, a dentist of Corpus Christi, Tex., has developed a new method of drilling teeth that works on the sandblasting principle. A jet of compressed air, carrying finely divided particles of aluminum-oxide abrasive, is directed through a tiny nozzle having an orifice only one-fiftieth inch in diameter. There is a vacuum attachment for collecting the powder after it has done its work. It is claimed that the operation is painless, as it eliminates the jarring and grinding of the conventional dentist's drill. Furthermore, the expanding air keeps the tooth pleasantly cool. The invention, which Doctor Black calls "airbrasive," has been reported upon in the *Journal of the American Dental Association* and also publicized in *Time*. It will not be placed on the market, Doctor Black says, until he has used it another year to satisfy himself that it is entirely satisfactory.

★ ★ ★

Furs To Be High

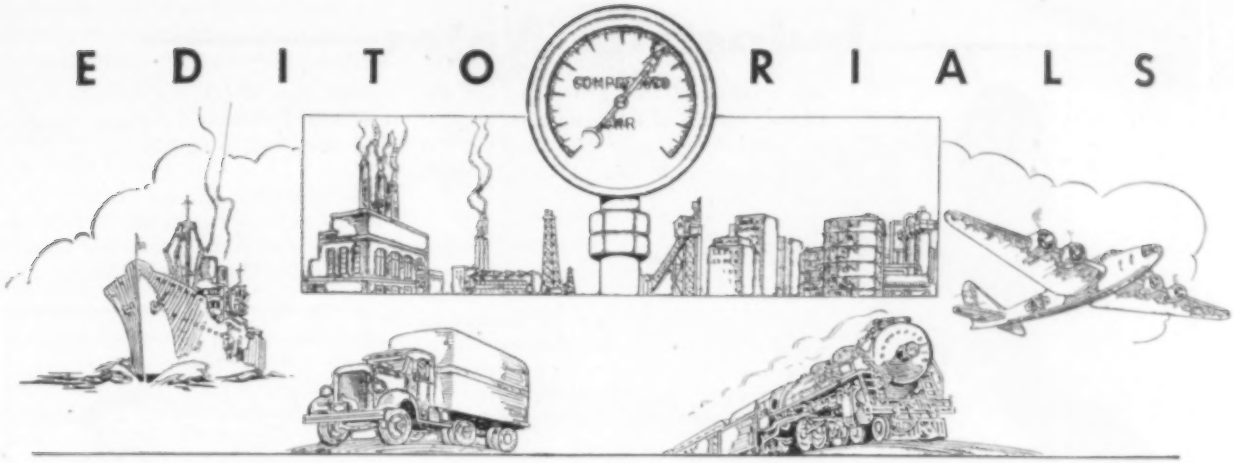
Recent record prices paid for fur pelts at Canadian auctions forecast higher costs for fur coats next winter. Top figures for single skins at one recent sale were: ranch mink, $42; wild mink, $67.50; marten, $160; fisher, $185; standard silver fox, $105; platinum fox, $230. Even the lowly muskrat, from which Hudson Seal is made, commanded a fancy $4.70. It takes 80 mink pelts to make a coat and, at $67.50, they would cost $5400. Add workmanship, profit, Canadian tax, and incidentals, and you arrive at around $10,000 for the finished garment.



BUZZARD BUSTER

This ingenious contraption was devised to dissuade buzzards and other large birds from lighting on poles of the electric transmission lines of the Andes Copper Mining Company in Chile. The birds have a habit of settling on the crossarms, just above the insulators, and sometimes cause short circuits. This apparatus is mounted on the crossarm and is normally in the position in which it is seen at the left. The other picture shows what happens when a bird rests its weight on the perch. The three prongs come up quickly and whang Mr. Buzzard fore or aft, depending upon which way he is facing. There is a startled squawk, and after disengaging himself from the prongs, which is sometimes quite a job, he spreads his wings and takes off without delay for parts unknown. A counterweight restores the prongs to normal position after the bird leaves. Those who have seen this rig work say that its efficiency is truly marvelous. Credit for its design is attributed to J. N. Pyster, who was formerly resident engineer at the Andes power plant in Barquito, Chile.

EDITORIALS



CAST IRON

MOST heavy parts of machinery and a great many of the lighter ones are either cast or forged, with castings far exceeding forgings in point of tonnage. Since pre-Christian days, gray iron has been the leading casting metal, and it continues to make up the backbone of the founding industry despite the rise of other metals. Excepting the output of blast furnaces and steel mills, gray-iron foundries turn out a greater tonnage than all other producers of engineering materials combined.

During the war period there was a tendency to minimize the importance of cast iron. Airplanes called for aluminum, tanks and guns for steel, and so on, and the people in Washington weren't cast-iron conscious. W. W. Rose, executive vice-president of the Gray Iron Founders Society, Inc., recounted in a recent article in *The Foundry* that he made many trips to the nation's capital and wore out a lot of shoe leather trying to interest the Army and the Navy in cast iron. These departments claimed that cast iron shatters under the impact of high explosives, and they even talked of abondoning the conventional gray-iron piston engine in trucks and tanks for rotary airplane types.

The movement never progressed that far, however, and eventually those directing the war effort agreed that cast and malleable iron were the best obtainable materials for certain uses. Meanwhile, some of the smaller independent gray-iron foundries had been forced to close, and many of the larger ones had lost a lot of their labor to the more glamorized war industries. The foundrymen began to realize that they had been taking too much for granted; that the things they knew about their product were meaningless to the average person who thought of cast iron only in terms of sash weights, fire plugs, manhole covers, and the like. To correct this misapprehension they turned to publicity through trade journals and newspapers, having first failed to put over their message through leaflets distributed to everybody in OPA and WPB.

Actually, a lot of cast iron is used for the commonplace articles mentioned, but nowadays a lot more of it is going into products that call for great strength and other physical properties usually associated in the lay mind only with steel. Metallurgical advances have shown how these *desiderata* can be obtained. More details concerning them are given in an article in this issue.

As we change from a wartime to a peacetime economy, cast iron will come back into its own. Many articles on which there is a great demand backlog require much of it. To cite just one example, the average automobile calls for the use of 512 pounds of cast iron. Meanwhile, the industry has problems to solve. Foundries have not been the most desirable places in which to work, and attention is now being given to improving working conditions and instituting better housekeeping methods.

CAN YOU SPARE ANY OF THESE ISSUES?

A TYPICAL request for back issues of this publication reads in part: "We are endeavoring to help in restoring the technical library in The Hague, Holland, pillaged and wrecked by the Nazis, and to fill in a five-year gap in Dutch technology and scientific progress caused by Nazi occupation."

We cannot make up full sets to supply these demands because we are short on some issues. We need copies of the following: 1940, all months except May, June, and December; 1941, all months except February, November, and December; 1942, May and June issues; 1943, January; 1944, January.

If you have any of these issues and are willing to give them for the purpose stated, please mail them to The Editor, Compressed Air Magazine, Phillipsburg, N. J.

CAN MANKIND HANDLE IT?

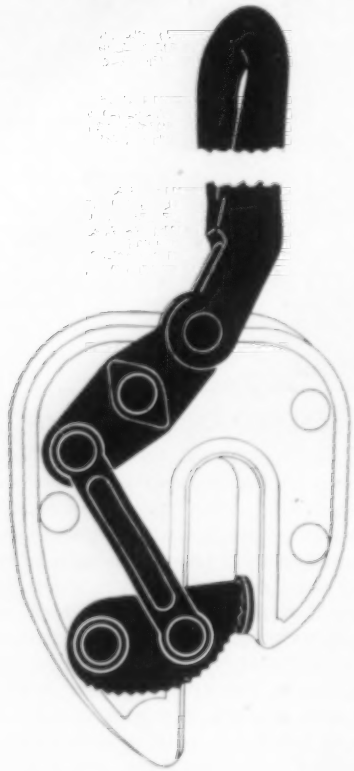
THE creation of the atomic bomb was without doubt one of the greatest scientific achievements in history. Whether or not it was in the best interests of humanity remains to be seen, and the answer may not be given in our lifetime. It is ridiculous to hope that the secret of the bomb can be kept inviolate. It is conceded that Nazi Germany was well on the way to discovering it when she was bombed into submission. Sir James Chadwick, chief British scientist identified with the atomic project in this country, says that capable researchers of any nation could learn how to make the bomb in about five years, provided they had access to the necessary raw materials.

Had the advent of such a lethal weapon been foreseen, its use would certainly have been barred by international law, just as the employment of poison gas was banned. However, the real reason gas was not resorted to in the war just concluded was not its illegality but the fact that no belligerent dared risk it, knowing full well that any attack with it would be returned in kind. The atomic bomb will likely also be outlawed, but there is no guaranty that all nations will abide by the edict, for sneak assaults could conceivably reduce most of a country to rubble before any retaliation could be made. If we doubt this, let us reflect on what would have happened to us had Japan possessed the secret of the bomb when she struck at Pearl Harbor.

The Swedish scientist Alfred Nobel lived to regret that he had given dynamite to a world that used it to make warfare more horrible and sought to offset the harm done by establishing an annual cash award for the promotion of peace. The futility of his effort is shown by the history of the past 30 years.

It is to be fervently hoped that atomic power will be turned to its many potential uses that will benefit mankind. Time alone will tell whether that is to be the case. Meanwhile, the atomic bomb is truly a Sword of Damocles hanging over the head of Civilization.

Industrial Notes

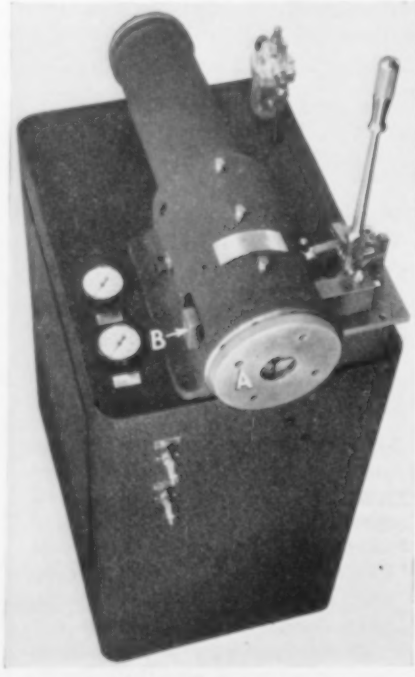


A lifting clamp that features a combination pressure and wedge grip is being manufactured by Merrill Brothers and is designed for the handling of plates or other metal products such as drums, stampings, or welded assemblies that offer a sufficiently flat surface to the jaws. One of the latter functions on the cantilever principle; the other, which is of special construction, is stationary and gives the clamp the grip that, it is said, prevents the load from slipping even though coated with grease or oil and irrespective of the position of the clamp. Release of the jaws is instantaneous and automatic as soon as they are relieved of their burden. The Volz Flat Surface Lifting Clamp, as it is designated, is available in four sizes ranging in capacity from ½ to 6 tons and takes thicknesses from 0 to 2 inches. Each is tested before shipment at double its rated load.

Induction heating equipment for the continuous surface hardening of shafting and tubing has been announced by Lepel High Frequency Laboratories, Inc. As the work moves at a predetermined speed through the heating and quenching coils it is rotated slowly, resulting in what is said to be a superhard skin with superior wearing qualities. Further claims made are that the high frequencies developed—100,000 to 450,000 cycles—speed up heating and thus prevent surface decarburization and scaling, leave the core structure unchanged, maintain high ductility, and make it possible to use ordinary carbon steel for many purposes that ordinarily call for alloys. Depth of hardness is controlled by regulating the power input or the speed at which the tubing passes through the coils.

Described as a combination reflector and protector, Hornlume roof coating is said to lower temperatures within structures as much as 22°. The material consists of asphalt containing practically pure metallic aluminum that remains on the surface after application and reflects the sun's rays. Coating is done in one operation either by brush or air spray.

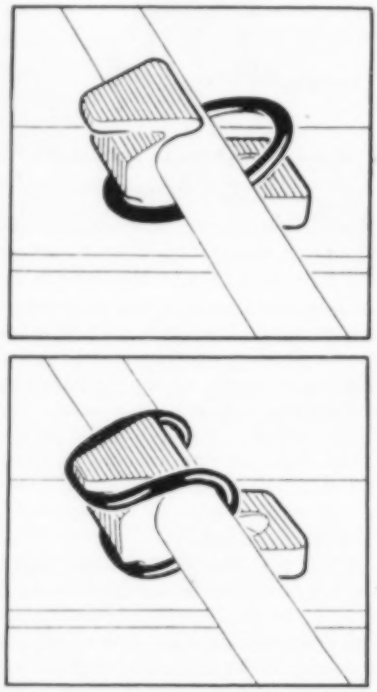
It looks like a cannon, but it's a double-lap flaring machine known as the Model DF Tube Master. It was originally designed for the aircraft industry to give tubing an extra thickness of metal at the flanges to enable it to carry greater working pressures and to prevent failure at connections. The machine is operated with compressed air at an average line pressure of 100 pounds by shifting a lever. The latter indexes at three positions and successively opens dies for the insertion of a tube, then flares and laps it. Output is said to be at the rate of 400 to 600 an hour, depending upon the aptitude of the operator. Although intended for nonferrous tubing ranging in size from ⅛ to ½ inch, the equipment can handle ⅛- to ⅜-inch annealed ferrous tubing when fitted with special dies, which the manufacturer—Leonard Precision Products Company—is prepared to supply.



LAP FLARING MACHINE

Interchange of flaring dies and punches is effected by unscrewing the face plate *A* from the head and sliding out the tool bar *B*.

Development of a new type of clamp that is especially suitable for tube- and conduit-type installations has been announced by The Glenn L. Martin Company. It's a 2-piece affair, the construction and application of which are plainly shown in the accompanying drawings. The base can be made of metal or plastic and is held in place by an ordinary screw, while the ring-shaped clamping member requires the use of a flexible material such as high-grade synthetic rubber. The latter serves also as a shock absorber and can be replaced without removing the base. While initially designed for fastening hydraulic and compressed-air lines, electrical conduits, and wire bundles in airplanes built by the company, the device can be utilized for attaching plumbing and for other domestic and industrial purposes. However, in such cases it would be necessary to substitute a fiber-glass for the rubber ring to assure longer service life. Large-scale production of the clamp is to be started soon either by the organization itself or a licensee.



For the removal of deposits of carbon from metal, E. A. Gerlach Company is offering a chemical that is mixed with water and heated. It is said to soften hard carbon on metals other than magnesium and cadmium when the parts are submerged in a closed tank and the bath is maintained at a temperature of 240°F. and under a pressure of about

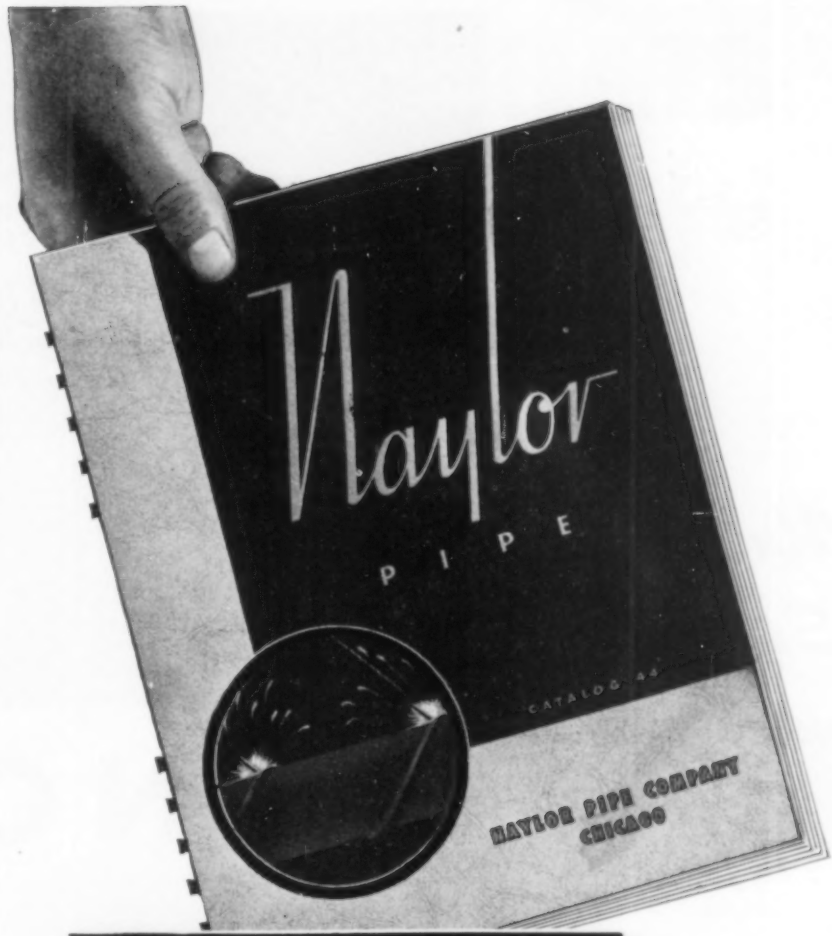
40 pounds. An open bath at 140° will remove soft carbon from metals, including magnesium and cadmium. The chemical has been used by the armed forces, but is now available for general application. It is known as No. 99 Decarbonizing Compound.

Ampco Metal, Inc., is making bearing bronzes in rod form in which it is especially suitable for fabrication on automatic screw machines. The material is produced in mill lengths by the continuous withdrawal of the molten metal from the bottom of the crucible, where it is free from dirt and dross. As it leaves the latter it solidifies and is held to close dimensions by passing through a cooled die. Structure of the rods is said to be uniform—lead content or other secondary constituents being dispersed in a finely divided state throughout the entire section.

Mine Safety Appliances Company has announced a new rock-dusting machine—the Bantam—that combines the advantages of the high-pressure type with those of the portable, low-pressure unit. It is mounted on three pneumatic tires, pulled around by a long handle, and carries 50 feet of 2-inch hose to facilitate distribution in inaccessible places. Air consumption is said to be low, and the force with which the dust is applied causes it to stick to the ribs and roof. The equipment is especially designed for use in trackless mine areas.

A new lubricant for internal-combustion engines and other applications has been prepared by the Carbide & Carbon Chemicals Corporation and is being produced on a commercial scale. It is a waxfree compound that is not a petroleum derivative and is said to have advantages over mineral oils, especially for use in cold weather. According to the manufacturer, the lubricant can be given any desired viscosity, which varies little with changes in temperature, and flash points range from 300°F. up. It virtually eliminates sludge and varnish formation in engines. Water-soluble and water-insoluble types are available.

A telephone powered by the human voice has won for its inventor, Franklin Griffiths, the highest award of the U. S. Department of the Interior—$1000—for outstanding achievement. The instrument is actuated by harmless electric waves set up by throat vibrations and is intended for rescue work in mines where the use of regulation battery-powered telephones is precluded because of the danger of explosions through sparks. It consists of a highly sensitive transmitter that is attached to the throat of the rescue-crew leader underground and is connected by a 2-strand wire to the telephone above ground.



POST-WAR GUIDE FOR PIPE USERS

On what applications can light-weight pipe do a better job for you? Why does Naylor Pipe provide advantages found in no other light-weight pipe? What new Naylor development has revolutionized pipe coupling? The answers to these and many other questions of importance to you are presented in the new Naylor Catalog just off the press. Here is a practical guide that provides a working tool for everyone planning post-war piping.

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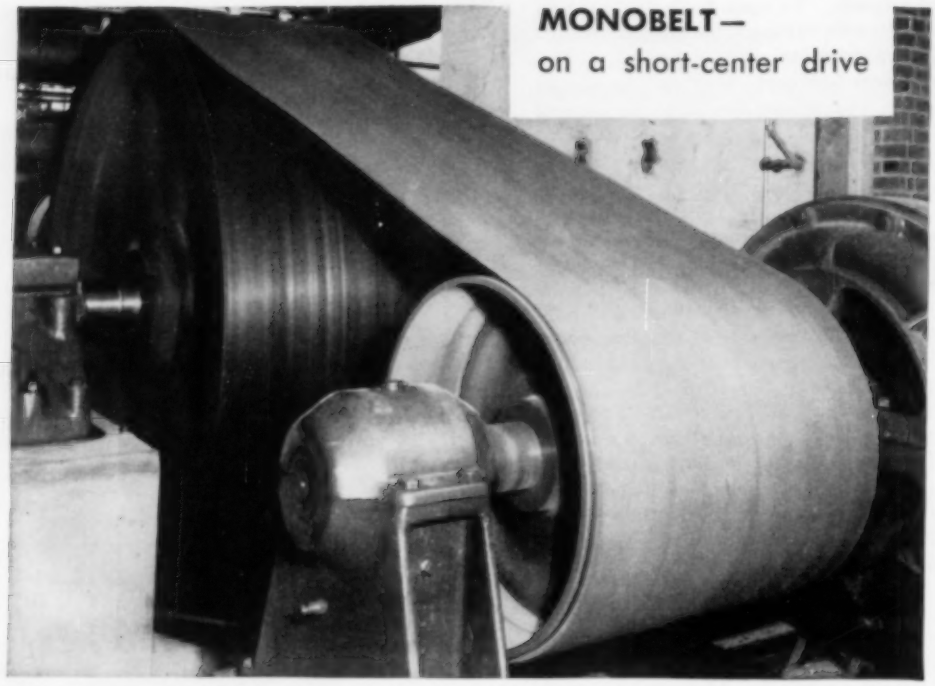

MONOBELT—
on a short-center drive

Uniform Speed is more certain with

MONOBELT

(PATENTED)

In no other use, perhaps, than in compressor drives, is the superiority of *leather belting* so conspicuously evident.

And "MONOBELT"—by reason of its unique quality and structural design—is preeminently the most suitable belt for the purpose.

"MONOBELT" because of its patented construction makes perfect pulley contact

Its flexibility and high friction coefficient assures its gripping the pulleys and delivering maximum horsepower continuously.

Learn more about the superiority and great economy of "MONOBELT," particularly on pivoted motor base drives operating compressors. Write for illustrated catalog.

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WHY DO YOU FIND MAXIMS *on the really* TOUGH *silencing jobs?*

The giant Maxims standing out against the skyline below quiet the exhaust of Diesels on test stands at a large industrial Diesel manufacturing plant. Time and again in important installations of this kind and in many smaller installations where the silencing problem is none the less critical, the most satisfactory answer has been found with Maxims.

The reason "why" is threefold and lies in *experience, performance* and *adaptability*.

- Maxim can show more years of research and experience in solving tough silencing problems.
- Maxim performance over the years is typified in thousands of successful working installations, large and small.
- Maxim adaptability means a line of silencers so varied that it is seldom necessary to go beyond the standard silencers to get a job "tailor-made" for your installation.

By the same token when special silencers *are* needed, Maxim engineers, constantly working on development and new design problems, are particularly capable of solving your special problems.

MAXIM EXHAUST & INTAKE SILENCERS

WRITE FOR BULLETINS
D 125
D 127
D 101
D 37

These Maxim Silencers (model MUC illustrated) are designed to silence the exhaust or intake of internal combustion engines, steam engine exhaust, air compressor intake, vacuum pump discharge and the intake or discharge of blowers of the positive pressure type. Wide choice of models to fit varying space and silencing requirements. Spark arresting where necessary.

MAXIM HEAT RECOVERY SILENCERS

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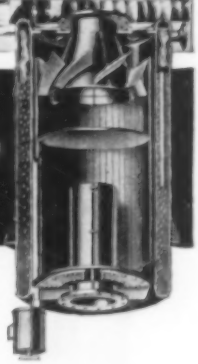

Maxim Heat Recovery Silencers combine efficient silencing of engine exhaust with spark arresting (where necessary) and with the efficient recovery of waste exhaust heat to produce steam or hot water for heating or processing operations. These Heat Recovery Silencers give highly efficient heat transfer . . . are available with automatic controls, and may be run wet or dry without injury to the unit.

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ARMY E NAVY

MAXIM

it's 10 to 1

if your plant needs a stoker

one of these types is the best answer

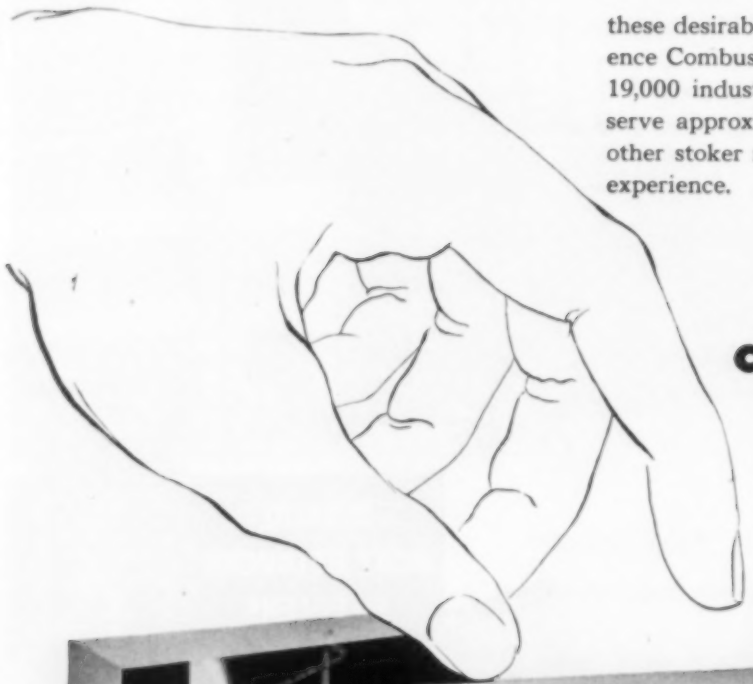
The prospect that high coal prices may prevail for a long time after the war provides a compelling reason for making certain that your next stoker will enable you to use efficiently the most economical coals available in your locality.

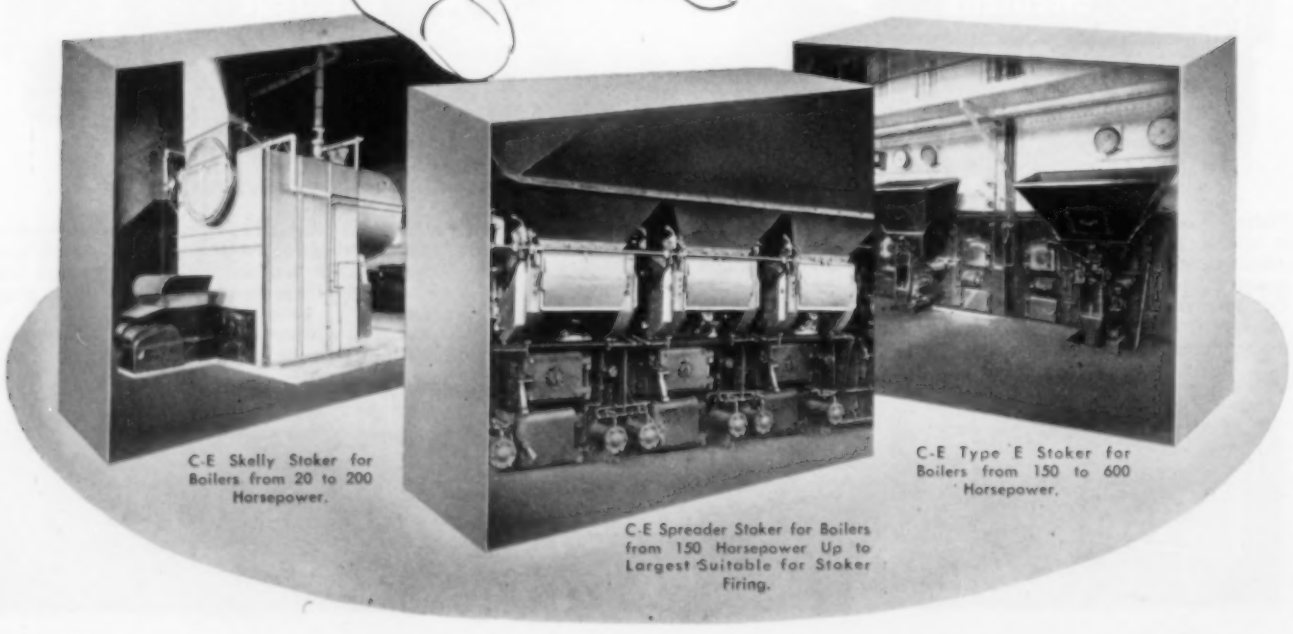
You can be sure of accomplishing this by entrusting your problem to the manufacturer who offers the most complete line of stokers—who has no prejudice in favor of certain types—who can prescribe and supply the *one* your conditions suggest. And that describes Combustion Engineering.

Yet, of the seven C-E Stoker designs, the three shown here have proved to be the most suitable for 90% of the many hundreds of C-E installations made in recent years. Hence it's 10 to 1 that one of these will be the best answer for you. But if you're the 1 in 10, C-E can fill the bill with one from among its remaining four designs.

In buying a C-E Stoker, besides the satisfaction of knowing you have bought the type best suited to your requirements, you also will have assured yourself of reliable performance and low maintenance. For these desirable qualities are inherent in the wealth of experience Combustion Engineering has gained in installing nearly 19,000 industrial stokers, large and small, of every type, to serve approximately 5,000,000 rated boiler horsepower. No other stoker manufacturer can offer you the benefits of such experience.

A-889





C-E Skelly Stoker for Boilers from 20 to 200 Horsepower.

C-E Spreader Stoker for Boilers from 150 Horsepower Up to Largest Suitable for Stoker Firing.

C-E Type E Stoker for Boilers from 150 to 600 Horsepower.

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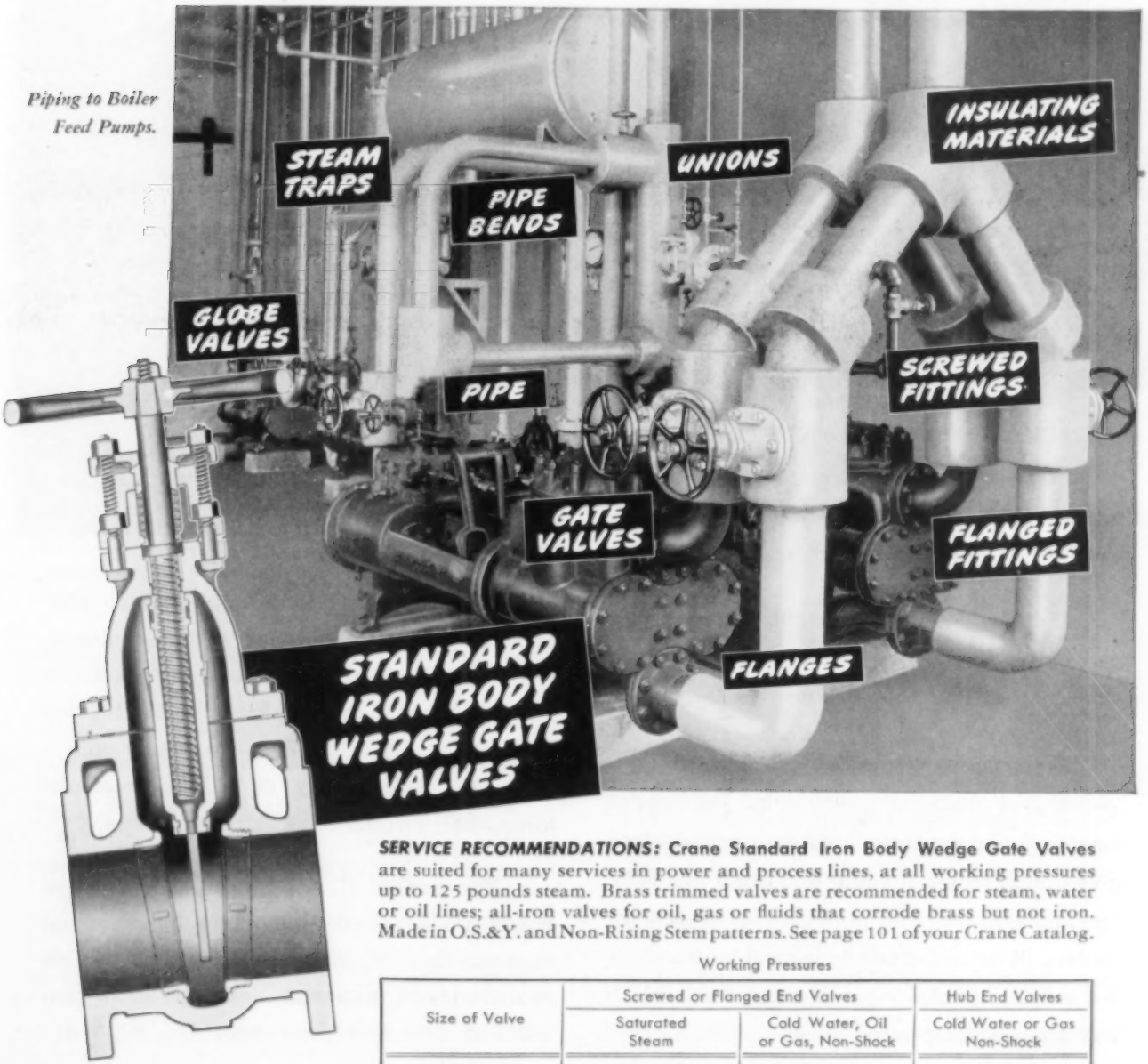
. . . For ALL Piping Materials

ONE SOURCE OF SUPPLY • ONE RESPONSIBILITY • ONE STANDARD OF QUALITY

By choosing Crane piping materials, you always have the advantage of the world's greatest selection—in brass, iron and steel. One source—your Crane Branch or Wholesaler—takes care of all your requirements. Thus, you are assured of uniform quality in all parts of piping systems—with single responsibility behind them. And because Crane complete piping material service simplifies ordering, it speeds up deferred replacement work . . . helps keep piping at peak efficiency. A typical Crane solution for many of your valve application problems is shown below.

Piping to Boiler Feed Pumps.



SERVICE RECOMMENDATIONS: **Crane Standard Iron Body Wedge Gate Valves** are suited for many services in power and process lines, at all working pressures up to 125 pounds steam. Brass trimmed valves are recommended for steam, water or oil lines; all-iron valves for oil, gas or fluids that corrode brass but not iron. Made in O.S.&Y. and Non-Rising Stem patterns. See page 101 of your Crane Catalog.

Working Pressures

Size of Valve	Screwed or Flanged End Valves		Hub End Valves
	Saturated Steam	Cold Water, Oil or Gas, Non-Shock	Cold Water or Gas Non-Shock
2 to 12 in.	125 pounds	200 pounds	200 pounds
14 and 16 in.	125 pounds	150 pounds	150 pounds
18 to 24 in.	*	150 pounds	150 pounds

*For steam lines larger than 16-in., Crane 150-Pound Cast Steel Gate Valves are recommended. (For sizes under 2-in., use Crane Clamp Gate Valves.)

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VALVES • FITTINGS • PIPE
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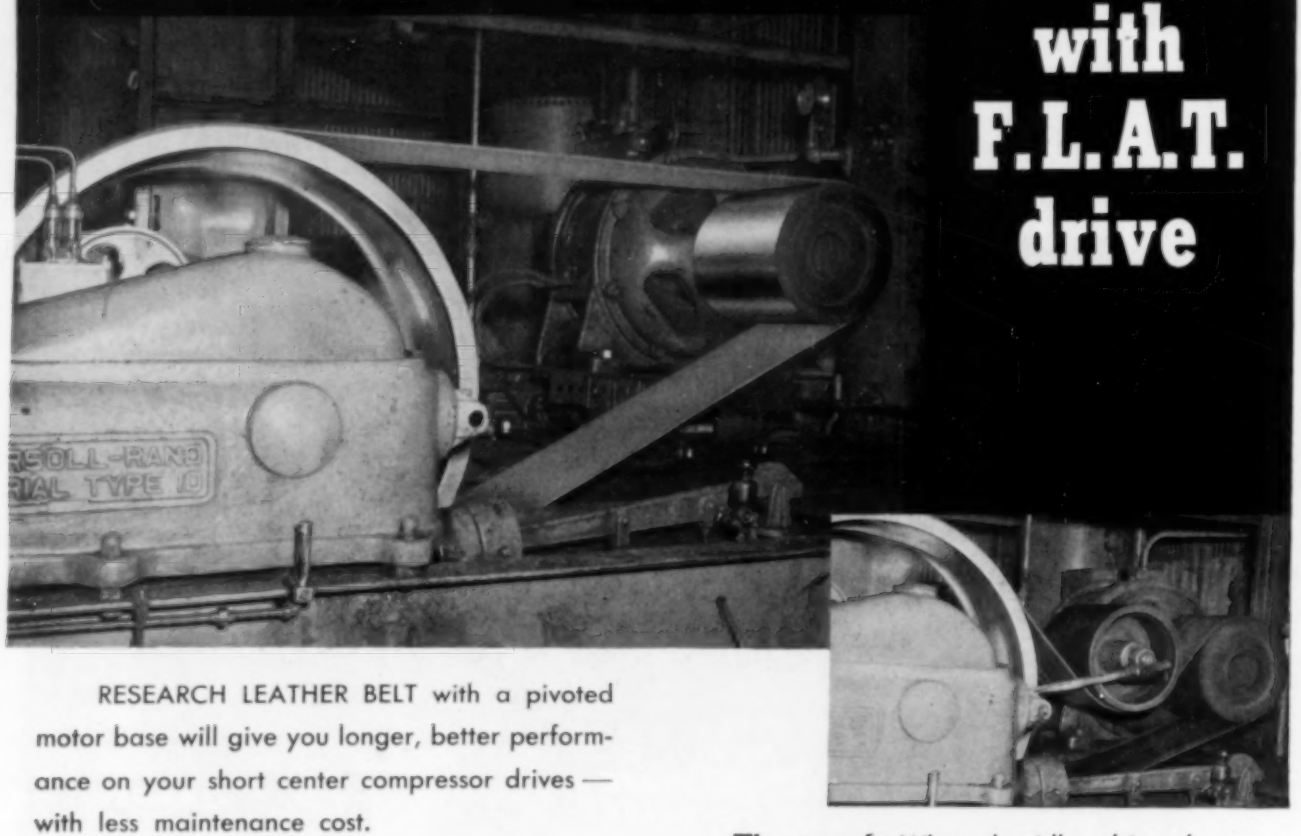


RESEARCH LEATHER BELT with a pivoted motor base will give you longer, better performance on your short center compressor drives — with less maintenance cost.

The Flat Leather Automatic Tension drive automatically provides proper tension through the action of the pivoted base.

Research leather belting provides minimum stretch and maximum pulley grip. The special manufacturing processes used in its manufacture give it high tensile strength and great flexibility for use with extreme pulley ratios and short centers. Its natural elasticity is ideal for handling the varying, fluctuating and shock loads which characterize compressor drives.

The proof: When the idler drive shown in smaller illustration caused maintenance grief and belt wear, Graton and Knight engineers recommended a pivoted base and Research Belt. The large illustration shows the result. Drive data: Motor, 100 H.P., 870 R.P.M.; motor pulley, 16" x 16"; driven pulley, 48" x 16"; center distance, 58"; pivoted base, Rockwood #14.

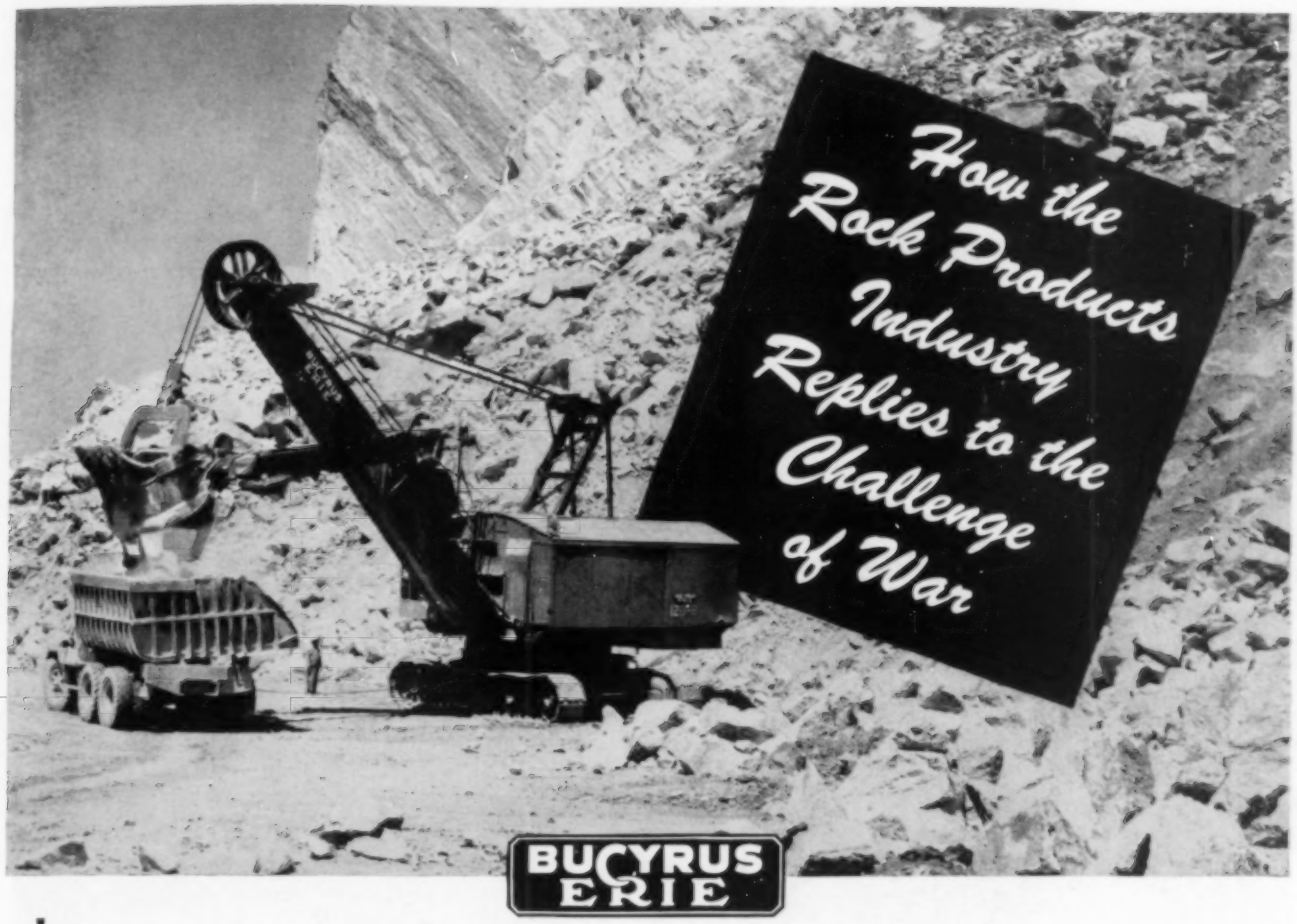
This modern F.L.A.T. drive transmits more power, eliminates idler bearing replacement and increases belt life. Moreover, there has been **no maintenance expense** since this drive was installed over two years ago.

Write Graton and Knight Company, 365 Franklin St., Worcester 4, Mass., for 56-page belting manual giving engineering data on this and other types of drives.

GRATON AND KNIGHT

Research Leather Belting

The most complete line . . . manufactured under one control from green hide to finished product. Graton & Knight distributors are listed under "Graton & Knight" in "Belting" section of Classified Telephone Directory and THOMAS' REGISTER.



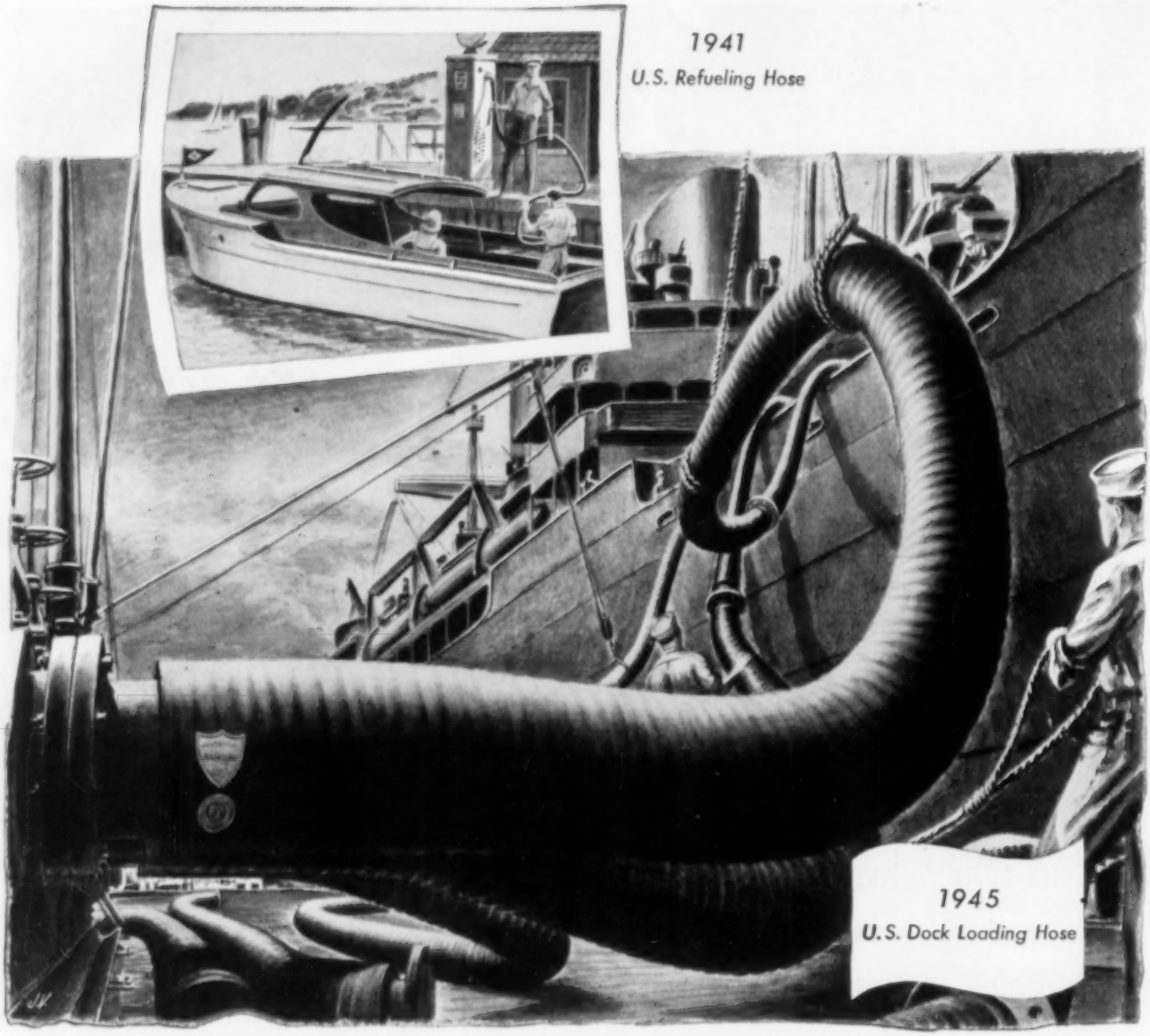
IN THE WAR YEARS of 1942-44, production of rock in the United States for construction, metallurgy, and agriculture totaled about 450 million tons — almost a 50% increase over the pre-war 1936-38 period, when about 310 million tons were produced. Impressive figures, these, but even more so in the light of a fact that the statistics do not reveal: although priorities permitted purchase of some new equipment, much of the tonnage was turned out with comparatively old machines in the face of war-induced shortages of both men and machinery.

In these big-production years, Bucyrus-Erie "years ahead" excavators, blast hole drills, and tractor equipment have helped their owners step up rock production by maintaining a high output pace. That is what they have always been built to do — why you can depend on them to help you meet tomorrow's peacetime challenge, too.

BL45

BUCYRUS-ERIE COMPANY

SOUTH MILWAUKEE, WISCONSIN



Thirst . . .

More gasoline and oil is pouring into the tanks of ships than ever before in maritime history. Fuel that is quenching the thirst of our transports and freighters.

Tough, husky hose is delivering it…hose that can stand rough handling at busy wharfsides, or take the buffeting encountered in a refueling rendezvous at sea. This kind of hose is different…fabricated of special synthetic rubber compounds, developed years ago by United States Rubber Company scientists—compounds that far excel natural rubber for handling petroleum products.

During the war these compounds have been improved not only for the handling of oil, but for carrying air, water, steam, gases and chemicals.

As production for civilian consumption mounts, use of hose will be extended…in your own plant, for instance, for high pressure hydraulic equipment or for carrying corrosive materials.

The United States Rubber Company technical staff is prepared to meet these needs with specially engineered hose for particular purposes. Their experience and their counsel will be at your command.

Serving Through Science

UNITED STATES RUBBER COMPANY

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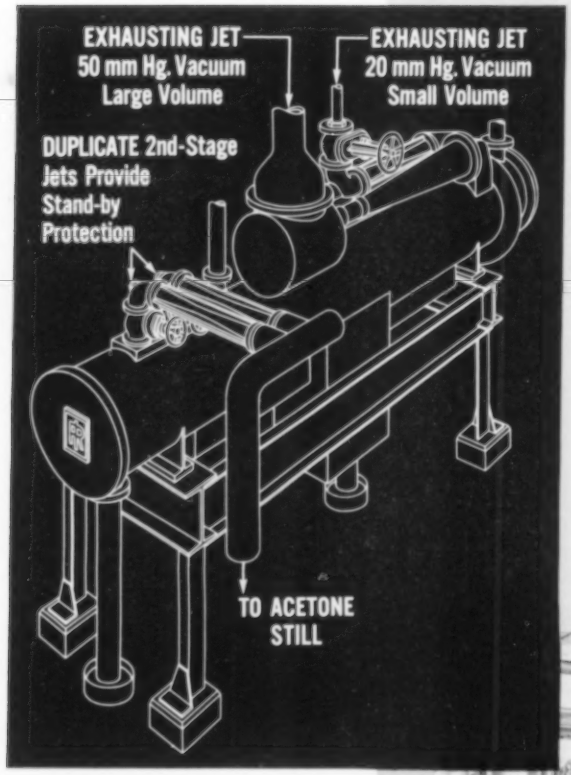
NOVEL STEAM-JET COMBINATION *Serves* PENICILLIN PRODUCER

One compact two-stage steam-jet exhauster arrangement solved a problem for the Commercial Solvents Corporation's penicillin plant at Terre Haute, Ind. As originally planned, two separate set-ups appeared necessary, since the acetone used to dissolve penicillin culture has to be removed from separate concentrating chambers which are under different vacuums—one at 20 mm Hg abs, the other 50 mm Hg abs. Moreover, considerably more acetone vapor had to be handled by the 50 mm Hg exhauster.

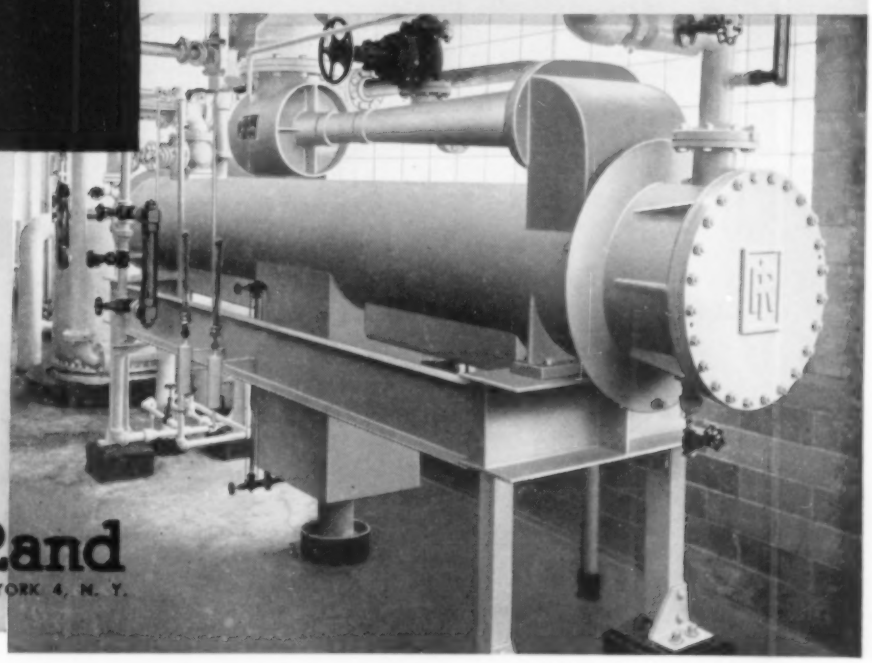


In working with the E. B. Badger Sons Company, engineers for the plant, Ingersoll-Rand vacuum specialists suggested this unusual combination of standard equipment:

Separate exhauster jets remove acetone vapor from the two concentrating chambers. Both of the jets selected have the same discharge pressure so they can exhaust to the same intercondenser, which is a surface-type unit.

Any vapors not condensed by the intercondenser are removed by a second-stage steam jet, which discharges directly into an acetone still.

Ingersoll-Rand has available a complete line of steam-jet ejectors, condensers and related equipment to help solve your commercial vacuum problems. Your inquiry is invited.



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TURBO BLOWERS
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The Sea-Bees say it's so!...

Moving forward with the Navy's valiant construction engineers on the rugged road to Tokyo . . . Victaulic Pipe Couplings have followed Marines onto many Pacific Islands . . . to supply vital fuel to mechanized units. The toughest proving grounds in the world have demonstrated that Victaulic is versatile . . . that it is wholly dependable under extreme installation conditions.

- SELF-ALIGNING
- FLEXIBLE
- RECLAIMABLE
- PERMANENT
- FAST AND EASY TO COUPLE
- NO MAINTENANCE

Victaulic Couplings are standard equipment for Navy Sea-Bees . . . and a profitable choice for your own industrial applications.

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SELF-ALIGNING PIPE COUPLINGS AND FULL-FLOW FITTINGS

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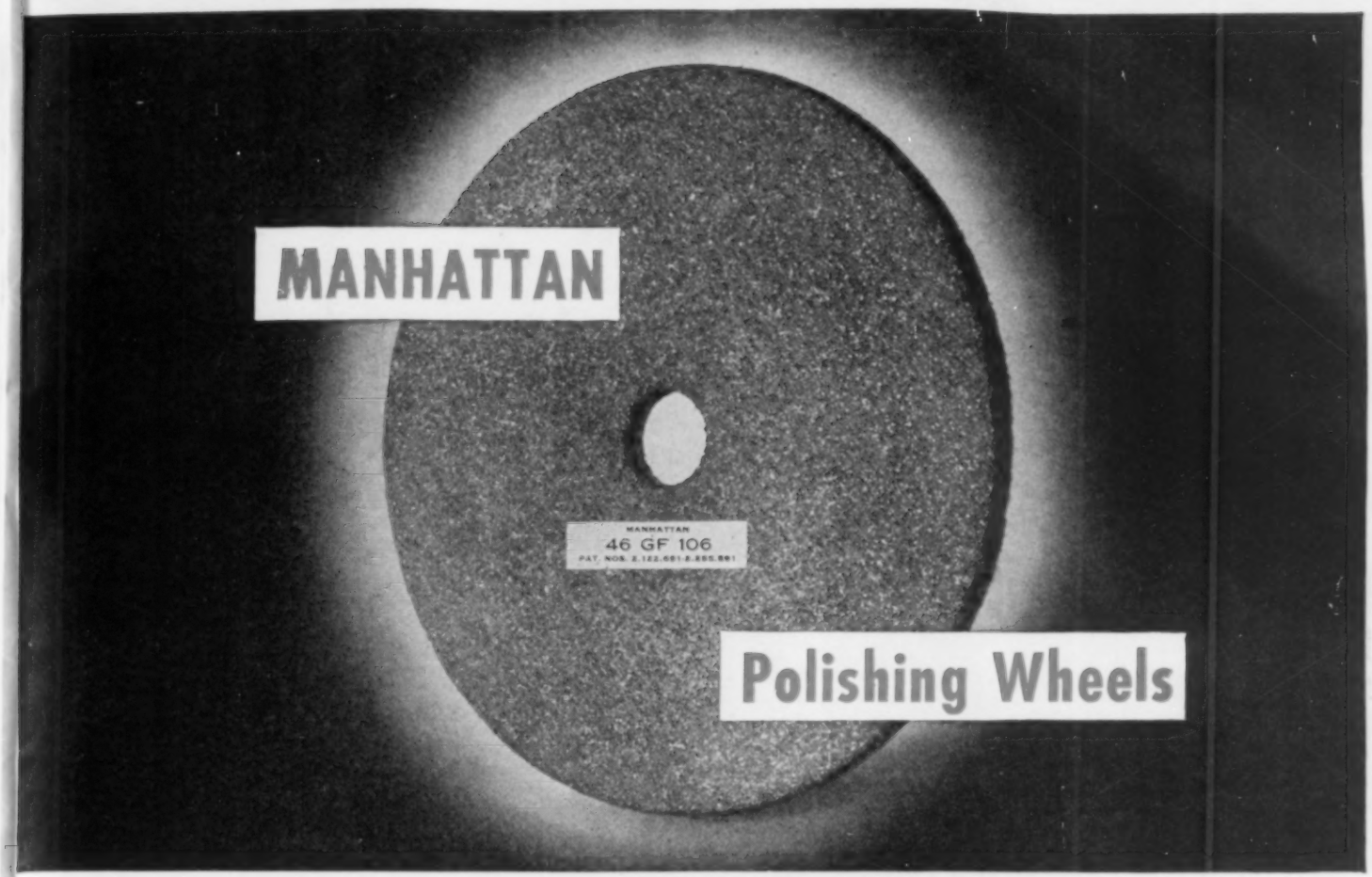
Used with Victaulic Couplings, Victaulic Full-Flow Pipe Fittings will pay you in pipeline profits through more efficient flow . . . increased delivery . . . reduced frictional losses . . . lower pumping costs. For complete details write for our new Victaulic Catalog and Engineering Manual . . . Address VICTAULIC COMPANY OF AMERICA, 30 Rockefeller Plaza, New York 20, N. Y. Other Victaulic offices—Victaulic Inc., 727 West 7th St., Los Angeles 14, California; Victaulic Company of Canada, Ltd., 200 Bay St., Toronto

OIL MINING MARINE MUNICIPAL INDUSTRIAL



New in several RESILIENCIES with synthetic rubber bond

Various degrees of resilience — from the hardest, carrying high abrasive content for metal removal with good finish, to the softest for high polish and ability to conform to irregular surfaces. MANHATTAN'S patented synthetic bond absorbs the shock of grinding and gives smoother wheel action and eliminates chatter.

Every MANHATTAN Abrasive Wheel is custom-engineered to your job . . . is a special-purpose wheel, designed and tailored to your specific need. An experienced MANHATTAN Engineer is always available to help you select the right wheel for your job . . . to determine not only the best abrasive material of the right particle size and cutting characteristics, but the correct bonds for the desired speeds, heat dissipation and resistance to wear. Consult our ABRASIVE WHEEL DEPARTMENT.

Other MANHATTAN Abrasive Wheels for Foundry Snagging, Billet Surfacing, Centerless Grinding, Cutting-off, Bearing Race Finishing and Semi-Polishing (Patent No. 2,122,691) remove metal fast with minimum wear.

ABRASIVE WHEEL DEPARTMENT

THE MANHATTAN RUBBER MFG. DIVISION

OF RAYBESTOS-MANHATTAN, INC.

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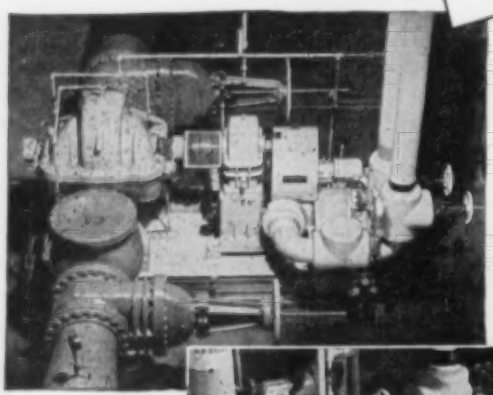
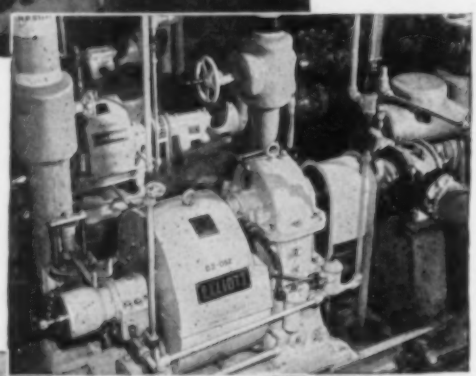
"to insure continuous service" *

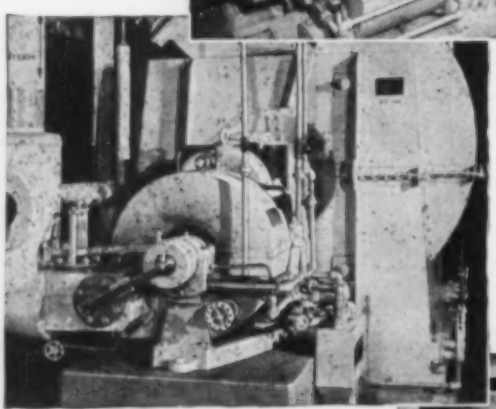
auxiliary drive turbines by . . ELLIOTT



At left: Elliott 250-hp turbine with built-in gear driving circulating water pump.

Below: In foreground Elliott 25-hp turbine with built-in gear driving fuel oil pump. In background an Elliott 20-hp turbine for a treated water make-up pump.





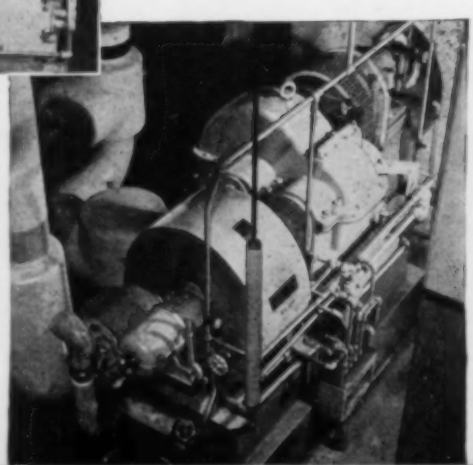
It took a war to do it—to call into being America's vast, hidden capabilities in manufacturing and ship building. The iron and steel plant of Kaiser Company, Inc., Fontana, Calif., is a famous example.

To build ships they needed steel plate. To make plate they built a steel plant. Built it fast—but carefully, served by selected and proven equipment . . . such as the nineteen Elliott mechanical drive turbines which power the steam plant auxiliaries and various pumps in the by-products plant. These are units that must keep going—and they do, with characteristic Elliott reliability. You might say the plant depends upon their faithful operation, and in a number of the drive functions it does.

Elliott mechanical drive turbines are selected for so many critical drive jobs that their sure performance has become almost traditional.

Built in several types, and supplied when required with built-in reduction gears. Full details in the descriptive bulletins, sent on request.

* *Quoted from an interesting descriptive article on the Kaiser Company's steam plant, by H. H. Hyde, project engineer, Bechtel McCone Corporation, published in a recent issue of POWERFAX.*



Above: Elliott 160-hp turbine driving forced draft fan through built-in gear. Most fans in the plant are dual driven. Special couplings between turbine gear and fan hold the turbine as a standby unit to pick up the load instantly upon power failure.

At right: Elliott 400-hp turbine driving induced draft fan. Turbine speed is reduced to fan speed by horizontally offset coupled gear.

ELLIOTT COMPANY

Steam Turbine Dept., **JEANNETTE, PA.**

Plants at **JEANNETTE, PA. — RIDGWAY, PA. SPRINGFIELD, O. — NEWARK, N. J.**

DISTRICT OFFICES IN PRINCIPAL CITIES

H-689-A

Powell's Past ...your assurance of Future Performance

For every problem in flow control, there'll always be a POWELL Valve to lick it!

Powell Valves for controlling flow in your industry were not just "born"—they're a product of evolution—the result of nearly a century of patient study, research and experimentation by Powell's staff of Engineers and Metallurgists. Therefore you can be sure TODAY that TOMORROW—as in the past—there'll be Powell Valves to meet every existing requirement for efficient, dependable flow control in compressed air services. The check valves shown here are especially adapted for use in air lines, the others for handling water for cooling compressors.

The Wm. Powell Company

Dependable Valves Since 1846

Cincinnati 22, Ohio

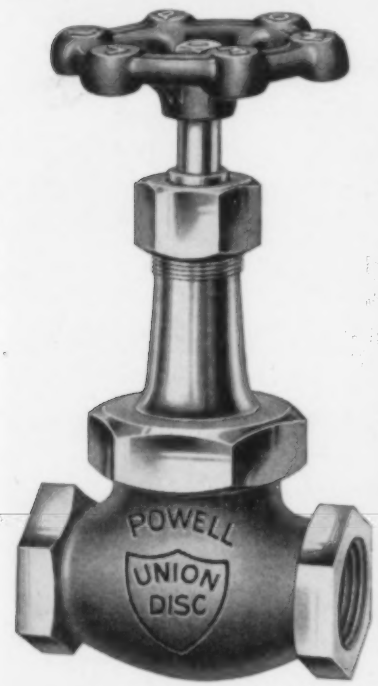
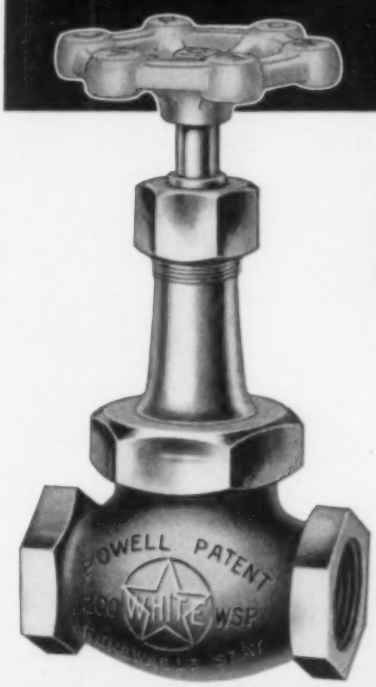


Fig. 150—A 150-pound Bronze Globe Valve with screwed ends, inside screw rising stem, union bonnet and vulcanized composition disc.

Fig. 95—A Bronze Dash Pot Valve for 200 pounds air working pressure. Designed for air compressor service. Has screwed ends, screwed cap and regrindable, renewable nickle-bronze disc. Because of the cushioning effect of the plunger in the dash pot, the seating of the disc is practically noiseless.



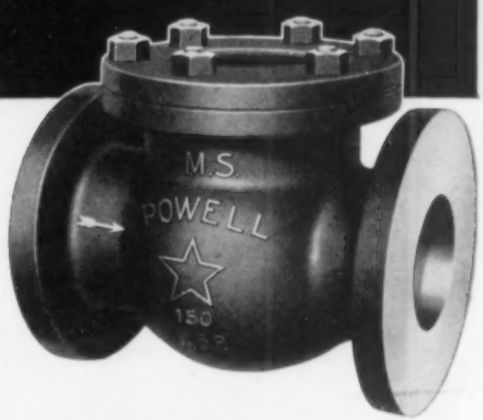
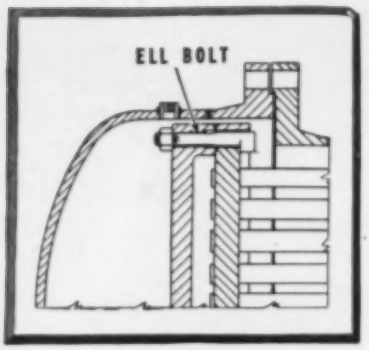


Fig. 312—A 150-pound Iron Body Bronze Mounted Horizontal Lift Check Valve, with flanged ends, bolted flanged cap, renewable bronze seat and vulcanized composition disc.

Fig. 102—A 200-pound Bronze Globe Valve with screwed ends, inside screw rising stem, union bonnet and regrindable, renewable nickel-bronze seat and disc.

POWELL VALVES

ELL BOLT
CONSTRUCTION
a feature of the Patented
VOGT HEAT EXCHANGER
Floating Tube Sheet Assembly



Patent Nos.
1,895,735
2,232,478

Assures
NO LEAKS HERE

YOU LOSE when an exchanger leaks . . . . with the possibility of fluid contamination, or shut down for repairs.

None of these evils need plague you when you employ the Vogt patented floating tube sheet assembly because there is no distortion of a split ring to worry about in making up the joint time after time. Its easy to make tight and it stays tight!

Critical materials are saved too because the design makes possible a smaller diameter of shell through reduction of the dead space between the shell and the tube bundle.

Our new bulletin HE-5 is a pictorial presentation of standard and special types of Vogt Heat Exchangers. Write for a copy on your letter head.

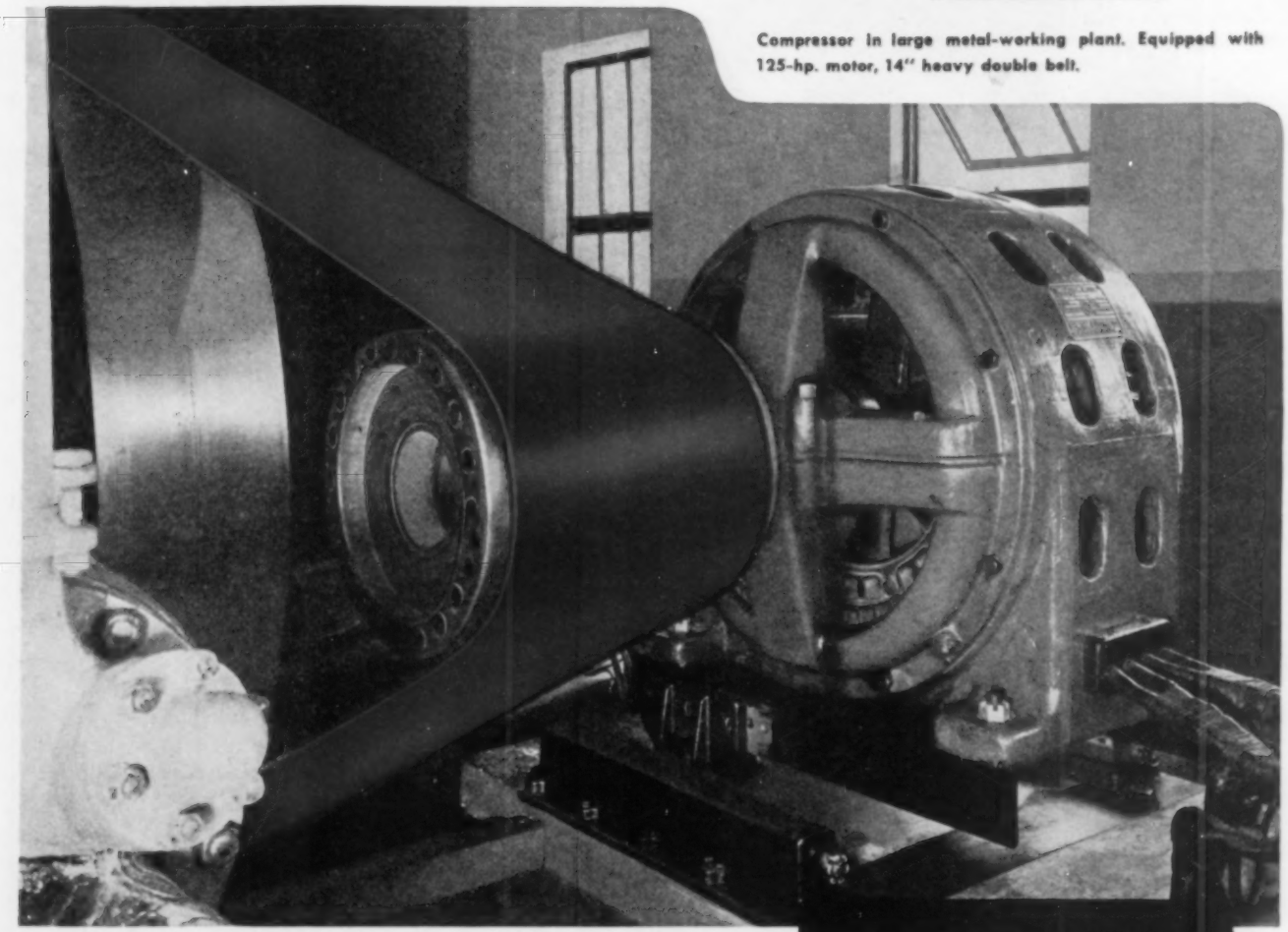
Saves
FLUID CONTAMINATION
•
FREQUENT SHUTDOWNS
•
CRITICAL MATERIALS

BUY WAR BONDS

HENRY VOGT MACHINE COMPANY
Incorporated
LOUISVILLE 10, KENTUCKY
Branch Offices: New York, Philadelphia, Cleveland, Chicago, Dallas.

Vogt *Heat Transfer* EQUIPMENT

Leather Belting
DOES THIS JOB BEST



Compressor in large metal-working plant. Equipped with 125-hp. motor, 14" heavy double belt.

Day after day, plant engineers are proving to their own satisfaction that a Leather Belt Drive on a Pivoted Motor Base produces *better* power transmission . . . more economically.

An important factor in the success of the Short Center Drive is the Pivoted Base which *automatically* maintains proper belt tension. After these drives are properly installed, it is unnecessary to "take up" the belt.

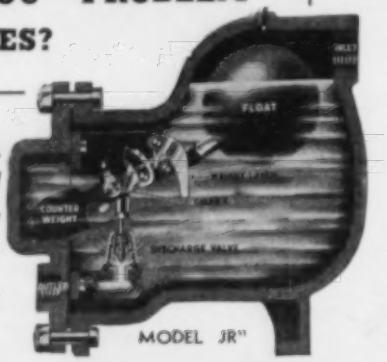
Add to this—permanent pulley-grip . . . longer life, and you'll see why Leather Belting is considered to be the most reliable and effective of any known belting material.

ENGINEERS AGREE . . . that the pressure of wartime production has emphasized the advantages of Short-Center, Flat Leather Belt Drives over Multiple V-Belts, especially on heavy-duty, larger units.

Leave it to Leather!

AMERICAN LEATHER BELTING ASSOCIATION · 41 Park Row, NEW YORK 7, N. Y.

HAVE YOU "PROBLEM" AIR LINES?



For Trouble-Shooting and Increasing Efficiency...

Install

NICHOLSON

COMPRESSED AIR TRAPS

They are plant-proved to be "America's fastest acting compressed air trap". Due to their exclusive weight-operated design they open and close instantaneously, giving full, positive, trouble-free drainage of water and oil. For most air applications, pressures to 200 lbs.

Write for Bulletin 341

W. H. NICHOLSON & CO.

180 OREGON ST., WILKES-BARRE, PA.

Valves ★ Traps ★ Steam Specialties

Specify **FARRIS RELIEF VALVES** *and you're safe!*

This FARRIS Diaphragm Relief Valve No. 1000, is now used on thousands of U. S. Naval and Merchant Marine vessels. No packing-gland — diaphragm sealed for back-pressure jobs. Now used extensively by refineries, power-stations, chemical and industrial plants on various operations requiring non-shock full-capacity relief at only 20% over-pressure and close regulation of operating pressure.

FARRIS DIAPHRAGM RELIEF VALVE, Type 1000. All bronze construction, open spring, meets Navy Spec. 45V26. For water, oil, steam, air; pressures to 150 lb. Sizes ½" to 2". Globe construction also.

Just one of the complete line of FARRIS Relief, Safety and Pop Valves. Write today for Bulletin.

Farris

SAFETY and RELIEF VALVES

FARRIS ENGINEERING CO. 354 Commercial Ave., Palisades Park, N. J.

BUY ALL THREE FOR ONLY $6.00

or ANY COMBINATION at PROPORTIONATE SAVINGS

COMPRESSED AIR DATA (Fifth Edition): 408 pages on the theory and practice of compressed-air engineering.

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CAMERON PUMP OPERATORS' DATA (First Edition): 170 pages of practical information for the man who installs, operates or services centrifugal pumps.

Fill out the coupon and mail it today. Be certain to check the group of books wanted.

COMPRESSED AIR MAGAZINE, 942 Morris Street, Phillipsburg, New Jersey, U. S. A

Please send me:

- ☐ Compressed Air Data, Cameron Hydraulic Data and Cameron Pump Operators' Data .....All three for $6.00.
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- ☐ Compressed Air Data and Cameron Pump Operators' Data.....Both books for $4.50.
- ☐ Enclosed is (money order) (check) for $.....) ☐ Send books C.O.D. I understand that the books will be sent me postpaid, and that they may be returned within 10 days if not satisfactory.

Name .....

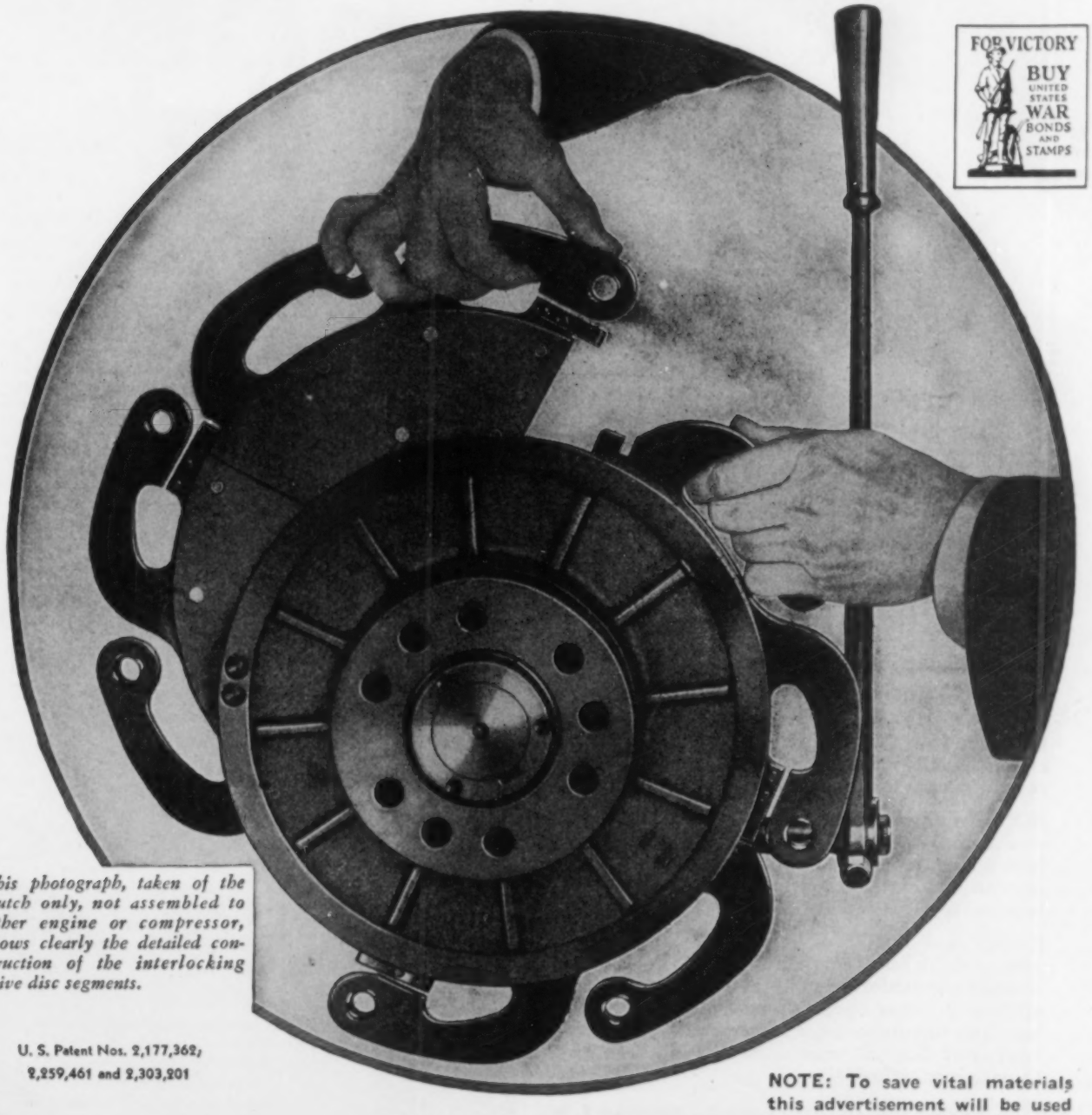
Company .....

Street No. .....

City .....State.....Country .....

FLEX-DISC CLUTCHES

Used on the entire line of I-R *Mobil-Air* Compressors, have a time proven drive disc with flexible fingers solidly bolted to the fly wheel. When the friction facings become worn these drive discs, which are quickly detachable in segments, may be removed and relined or replaced without disconnecting the engine from the compressor.



FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

This photograph, taken of the clutch only, not assembled to either engine or compressor, shows clearly the detailed construction of the interlocking drive disc segments.

U. S. Patent Nos. 2,177,362, 2,259,461 and 2,303,201

NOTE: To save vital materials this advertisement will be used for "the duration."

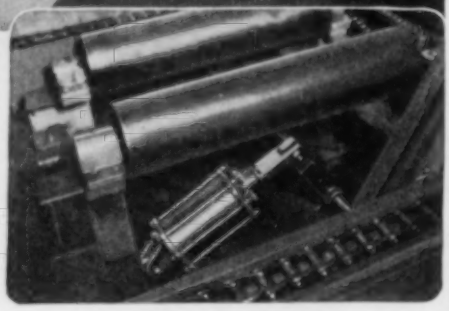
C. M. EASON, INDUSTRIAL CLUTCH CO.

Waukesha Wisconsin

One easy twist of the wrist puts into operation this multi-prong lift at the Pacific Lumber Company's plant.

•

Dependable NOPAK Air Cylinders do the work . . . replacing manual labor with tireless, instantaneously responsive air power.



Lumber Conveyor Sections Are **NOPAK** Controlled!

Here is another illustration showing how the Pacific Lumber Co., Scotia, Calif., employs NOPAK Air Cylinders and NOPAK Valves to control the flow of stock through different mill operations.

The workman manipulates a NOPAK Hand Operated Valve controlling a group of 10" NOPAK Air Cylinders, which raises the row of lifts at an angle. Gravity then transfers the partially processed lumber to the parallel conveyor at the left.

NOPAK cylinder power is used throughout Pacific's conveyor system to facilitate material handling with minimum manpower. It keeps production moving at a steady pace, eliminates delays and replaces tedious and tiring manual labor.

Similar uses of NOPAK Valves and Cylinders in your plant in pushing, pulling, lifting, holding or clamping operations may point the way to higher efficiency, lower operating costs, more efficient handling of cumbersome materials. Why not investigate? Consult your nearest NOPAK representative or write —

GALLAND-HENNING MFG. CO., 2759 S. 31st St., Milwaukee 7, Wis.

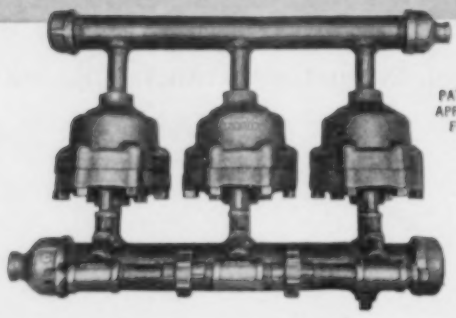
NOPAK

VALVES AND CYLINDERS

DESIGNED for AIR and HYDRAULIC SERVICE

A 4836-½

Purify Any Pressures, Air or Gas, with Bird-White Multiple Unit *Pur-O-fier*



PATENT APPLIED FOR

Three Models Available

Model A-1 furnished with a 1 inch turbo-rotor and will accommodate volumes from 1 to 8 cubic feet.

Model A-2 has a 2 inch turbo-rotor and can accommodate volumes from 10 to 35 cubic feet.

Model A-4 has a 4 inch turbo-rotor and can accommodate volumes from 35 to 100 cubic feet.

Bird-White multiple unit Pur-O-fiers save time and money by protecting air-operated machines, gauges and controls from contamination. They give positive purification to air or gas lines regardless of fluctuating pressures or high volumes.

The perfectly balanced Turbo-Rotor purifying action makes them sensitive to both regular and intermittent pressures. Write for Bulletin 10 giving complete details.

BIRD-WHITE COMPANY

Dept. CA, 3119 WEST LAKE STREET
CHICAGO 12, ILLINOIS

The Feminine Flourish

or the MASCULINE MAUL

No matter whose hand pilots a *Navigator Pencil* you'll find it giving yeoman service right down to the very end.

Uniform degree of texture — grading — quality — plus the results of years of experience in pencil manufacture, make the *Navigator* the "handy" pencil for men and women.

SEND FOR LEAFLET NO. 19

KOH-I-NOOR

The RIGHT pencil for the RIGHT job

KOH-I-NOOR PENCIL COMPANY, INC., BLOOMSBURY, NEW JERSEY

The STARTING POINT.....

JACKBITS

Changing to Jackbits will reward you with greater drilling efficiency and reduced costs. The experiences reported here prove conclusively that Jackbits are the starting point to better drilling.

Increase Tonnage — At one mine Jackbits increased the tonnage per miner's shift approximately 15%.

Cut Drilling Costs — In an open cut Jackbits effected a 13% savings in drilling costs amounting to $5500 per year.

Drill Deeper and Faster — The ability of Jackbits to put down deeper holes and to drill faster enabled one metal mine to break a greater tonnage, saving $73.80 per shift.

Reduce Steel Transportation — Jackbits conserved manpower by reducing the daily amount of steel transported in and around one mine from 69 tons to 1 ton.

Lower Drill Upkeep Costs — Sharp bits are used a greater percentage of the time when Jackbits are on the job. The energy of the piston blow is expended in cutting rock, not in rebound. The strain on rotation parts is also reduced. Operators report savings of 15% in rock drill upkeep costs.

Save Time — On one large tunnel job, the use of Jackbits produced an average saving of 26% in drilling time per round.

Easily Reconditioned — I-R Jackbits are backed by the only complete line of reconditioning equipment. As a result, reconditioning is easy and costs are low.

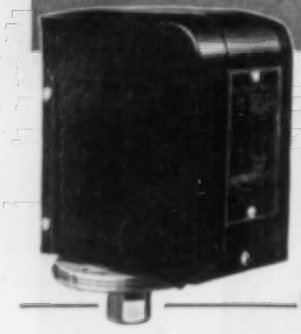
Let your Ingersoll-Rand branch tell you more about the economies resulting from the use of Jackbits.

15-630

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

for AIR COMPRESSORS *and* WATER PUMPS



Class 9013A PRESSURE SWITCH

225 lbs. pressure limit
10 to 45 lbs. differential

• A standard controller for motor-driven air compressors and water pumps. Heavy contacts, with silver permanently bonded to the heavy bronze backing. Generous electrical ratings. Four ⅞ inch knockouts for ½ inch conduit are provided for convenient wiring.

Modern black enameled steel cover. Corrosion-resisting inner parts. High-grade impregnated fabric diaphragm. Oil-resisting type also available.

Write for Catalog—illustrations, specifications of Square D pressure switches and related devices. Address Square D Regulator Division, 6060 Rivard Street, Detroit 11, Michigan.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

NORGREN INDUSTRIAL HOSE ASSEMBLIES

Dependable carriers of high or low, pneumatic or hydraulic pressures. Built tough and flexible, highly resistant to heat, cold, grease, solvent and vibration. Permanent couplings for high pressures and reusable couplings for low pressures.

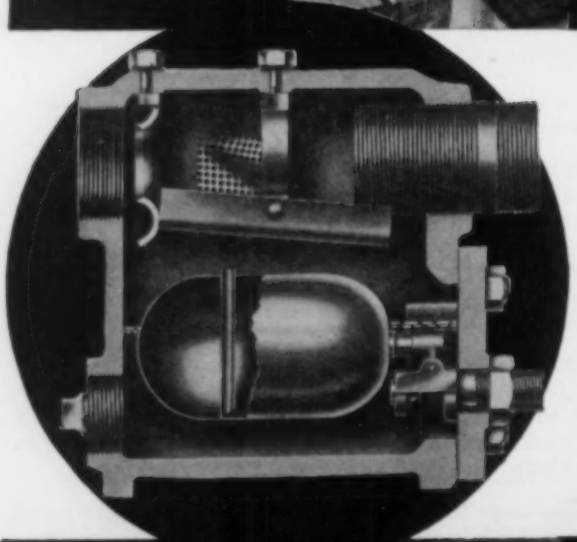
Write for new bulletin No. 450. C. A. Norgren Co., 220 Santa Fe Drive, Denver 9, Colorado.

Limber as a Lariat
STRONG as Steel

Norgren

DRI AIR MAY BE INSTALLED BY SUSPENDING IT FROM THE PIPING WITHOUT ANY OTHER SUPPORT.

INCREASED PNEUMATIC EFFICIENCY WITH THIS AUTOMATIC SEPARATOR



PROTECT EQUIPMENT WITH DRIAIR

SEPARATES • COLLECTS • DELIVERS

• DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

A TYPICAL INSTALLATION SHOWING DRI AIR STANDING ON A CONCRETE FLOOR NEXT TO THE WALL.

WRITE FOR BULLETIN DA WHICH FULLY DESCRIBES THE CONSTRUCTION AND OPERATION OF THE DRIAIR.

NEW JERSEY METER CO.

"SPECIALISTS IN COMPRESSED AIR DEVICES"

PLAINFIELD, NEW JERSEY

FOR BROADEST CORROSION COVERAGE

Rely on These 2 "Key" Alloys

TWO "key" Lebanon alloys with their variants cover a high percentage of industry's corrosion-resistant requirements. Circle Ⓛ 23 meets general needs for castings not subjected to severe corrosive actions. Circle Ⓛ 22 provides a superior degree of resistance over a broader range of applications.

Important variants of these basic alloys are Circle Ⓛ 22-XM and Circle Ⓛ 22-M. Circle Ⓛ 22-XM carries molybdenum which provides additional protection against the actions of many chemicals. Circle Ⓛ 22-M carries selenium to facilitate machining (with some loss of corrosion resistance resulting).

All four of these Lebanon alloy steels provide outstanding service over a wide range of applications. Lebanon will gladly furnish coupons for corrosion tests. For specific recommendations, forward service histories or arrange for a study by a Lebanon metallurgist or foundry engineer.

LEBANON STEEL FOUNDRY LEBANON, PA.

ORIGINAL AMERICAN LICENSEE GEORGE FISCHER (SWISS CHAMOTTE) METHOD

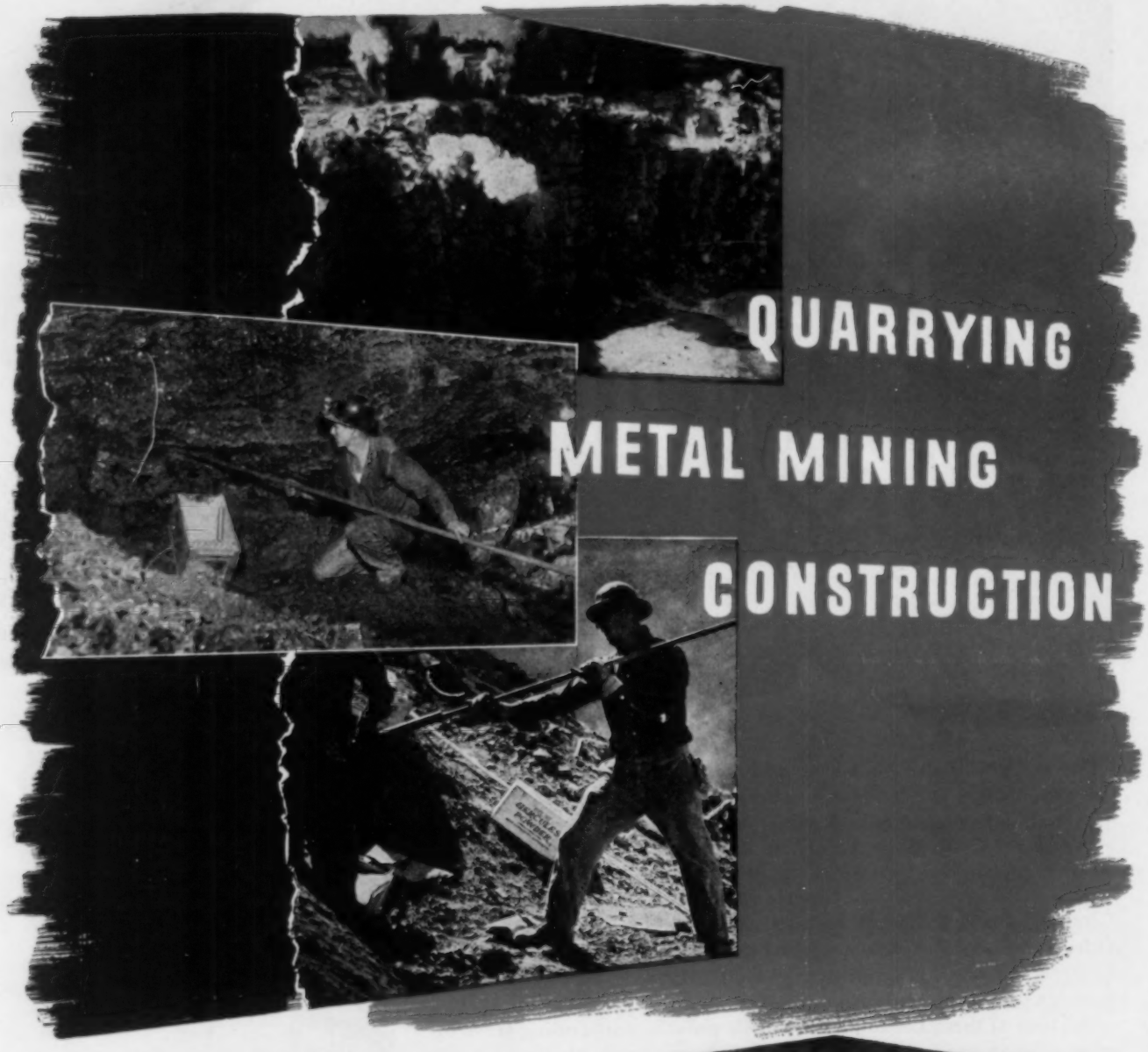
"In The Lebanon Valley"

This new bulletin combines data about Lebanon Circle Ⓛ 22 and Circle Ⓛ 23 (18-8 alloys) in a single, easy-to-use, file-size folder. You can quickly compare the basic alloys and their variants. Write today for your copy.

LEBANON CIRCLE Ⓛ 22 AND 23

Lebanon Designation	NOMINAL ANALYSES							NOMINAL PHYSICAL PROPERTIES			
	C.	Si.	Mn.	Cr.	Ni.	Mo.	Special	Tensile Strength	Yield Point	Elongation in 2"—%	Brinell Hardness
Ⓛ 22	0.07 Max.	1.25	0.75	19.50	9.00			75,000	36,000	50	135
Ⓛ 22-M	0.07 Max.	1.25	0.75	19.50	9.00		Se. 0.25	80,000	40,000	45	160
Ⓛ 22-XM	0.07 Max.	1.25	0.75	19.50	10.00	2.25		82,000	42,000	50	170
Ⓛ 23	0.20 Max.	1.25	0.75	19.50	9.00			75,000	36,000	45	140

Lebanon ALLOY AND STEEL Castings



IN quarrying, construction, metal mining, users of Hercomite* and Gelamite* are currently saving 10% to 15% of powder costs compared with older types of explosives.

Whenever their use is indicated, Hercomite and Gelamite give maximum breakage for every dollar. Proof of their efficiency and economy is to be found in their widespread use, both on the surface and underground. These high-cartridge count explosives are now more popular than ever before.

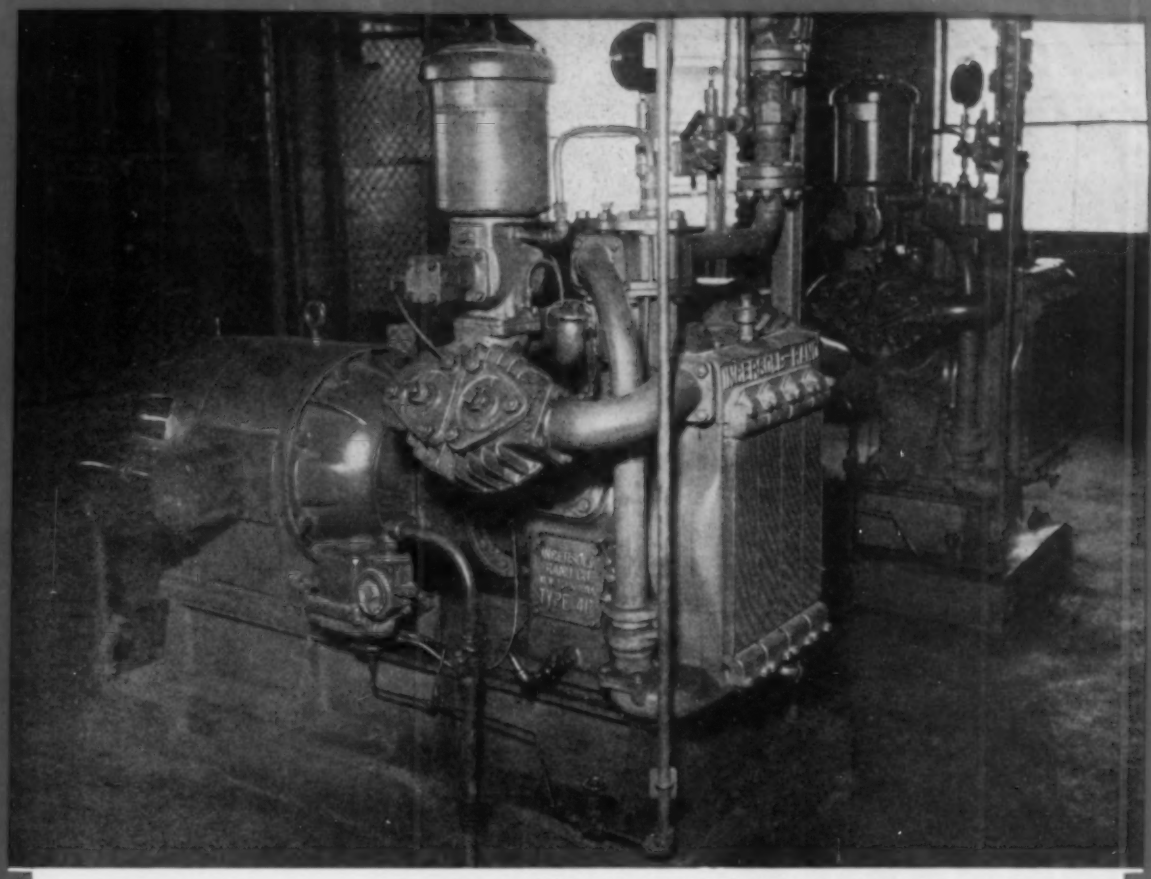
HERCULES

EXPLOSIVES DEPARTMENT

HERCULES POWDER COMPANY
INCORPORATED

932 KING ST., WILMINGTON 99, DEL.

*Reg. U. S. Pat. Off. by Hercules Powder Company



Ingersoll-Rand Model 25C, Type 40 Air Compressors equipped with Timken Bearings installed in a large eastern oil refinery. These units are 5¼" and 5¼" and 4"x 5" rated at 250 lbs.

Anti-Friction Compressor Performance

AT IT'S BEST

The Ingersoll-Rand Model 25C Type 40 Compressors shown in the photograph —like other I-R models, portable and stationary—have their crank shafts mounted on Timken Tapered Roller Bearings.

This assures anti-friction advantages in full — for Timken Bearings not only eliminate friction and wear; they also provide complete protection against radial, thrust and combined loads; and hold the crank shaft in dead accurate alignment under all operating conditions.

So, when buying anti-frictionized compressors—any type—make sure you get every quality you are entitled to; specify "Timken Bearing Equipped" and see that every bearing has the trade-mark "TIMKEN" stamped on it—proof of the genuine product.

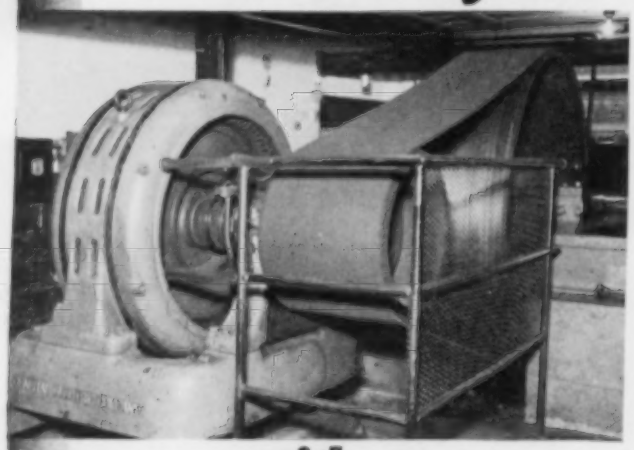
THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Minimize SHUTDOWNS-



with SCHIEREN LEATHER BELTING

ON A PIVOTED MOTOR BASE

Eliminate shutdowns and save precious man-hours! Cut out the time loss in frequent take-ups to compensate for stretch! Here's how: Simply combine SCHIEREN LEATHER BELTING— famous for quality for 75 years—with the constant, automatic, correct tension of a pivoted motor base on short center. SCHIEREN'S unsurpassed leather selection, tannage processes and belting workmanship assure the longest and finest belting performance. And that gives you less wear on bearings, smoother operation, and the utmost from your compressor. Write for our estimate on your next drive. No obligation whatever.

SCHIEREN QUALITY LEATHER PACKINGS

for every usual and unusual requirement give you lower annual packing cost and higher production efficiency. Send for catalog.

National Distributors of Rockwood Bases

CHAS. A. SCHIEREN CO.

LEATHER BELTINGS • SPECIALTIES

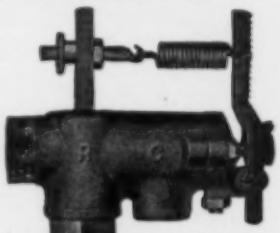
HYDRAULIC PACKINGS

30 FERRY STREET, NEW YORK 7, N. Y.

60 FRONT STREET, WEST, TORONTO, ONTARIO

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



R. C. PILOT VALVE STRAINER TYPE

R. CONRADER CO.

1207 FRENCH STREET · ERIE, PA.

PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

---

In Cleansing Compressed Air, Avoid Halfway Measures!

Most air separating equipment effects only partial removal of moisture, oil and dirt—not enough for the industrial requirements of today. Tool costs and spoilage of work are already assuming a new importance.

The Aridifier—through the correct application of centrifugal force continuously removes ALL contamination from compressed air; reducing maintenance cost of air-operated tools, precluding spoilage of sprayed finishes, and avoiding unnecessary work stoppage.

Write for Bulletin 543.

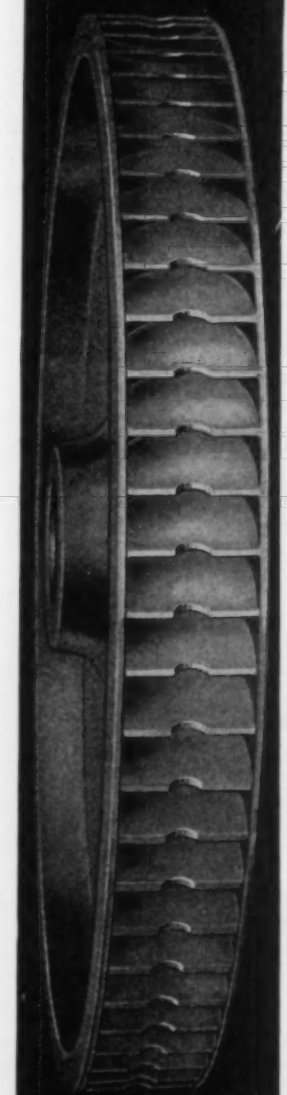
LOGAN ENGINEERING CO.

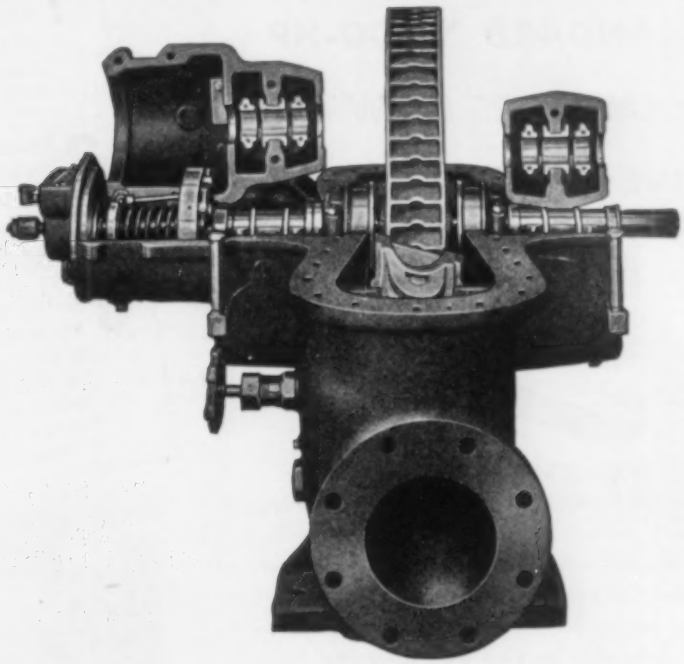
4911 Lawrence Ave., Chicago 30, Ill.

Logan ARIDIFIER

Dries and Cleans Compressed Air

TERRY





ROTOR AND BUCKETS ALL IN ONE PIECE

In the Terry Turbine the wheel is made from a single forging of special composition steel. The buckets are milled directly in the wheel, there are no parts to become loose or work out, such construction makes for long life and low maintenance.

This and many other features of Terry Wheel Turbine design are described in our Bulletin S-116. A request on your business letterhead will bring a copy.

T-1138

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Now UP TO 2000 hp!

STANDARD 2000-HP TRI/CLAD MOTORS NOW AVAILABLE

THEY GIVE EXTRA PROTECTION 3 ways

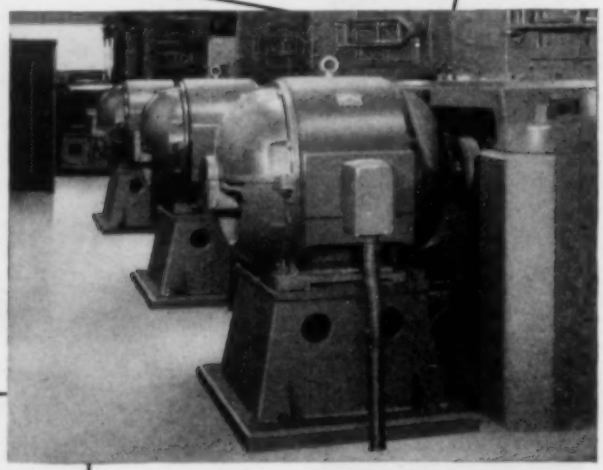
1 Extra protection from physical damage—Cast-iron construction. Upper portion completely enclosed. Streamline, cast-iron end shields. Corrosion-resisting finish.

2 Extra protection from electrical breakdown—Windings of Formex* wire, strongly bonded with oil- and moisture-resistant synthetic resins, stand up under abrasion or "heat-shock."

3 Extra protection from operating wear and tear—Sleeve or ball bearings, in dust-tight housings. Sleeve-bearing design is a further refinement of well-proved Tri-Clad bearing proportions, with cast-in "air seal" to further insure oil tightness of the housing.

The triple-protected construction that has made General Electric's Tri-Clad motor so popular in the small and intermediate sizes has now been extended to motors of 2000-hp capacity. On your *big* drives, these new Tri-Clad motors will meet severe conditions with greater assurance than ever of dependable service and long life.

The Tri-Clad motor, in its wide range of types and sizes, is industry's most popular integral-hp motor. Chances are there's a standard Tri-Clad to meet your requirements "on the nose." For information on G.E.'s complete line of Tri-Clad motors, ask for Bulletin GEA-3580. *General Electric Company, Schenectady 5, N. Y.*



Three of the new, large Tri-Clad motors, each rated 200 hp, 1200 rpm, driving coal pulverizers in a Southern steam-electric plant

*Trade-mark reg. U.S. Pat. Off.

HERE'S TODAY'S WIDER RANGE OF STANDARD SIZES	
TRI/CLAD Type K	—1 hp to 2000 hp at 1800 rpm
TRI/CLAD Type KG (High starting torque, low starting current)	—5 hp to 200 hp at 1800 rpm
TRI/CLAD Type KR (High starting torque, high slip)	—Available to 100 hp in speeds required for high-slip, flywheel drive (punch press, etc.)

Buy all the BONDS you can—*and keep all you buy*

GENERAL ELECTRIC

TRI CLAD MOTORS

MULTIPLY OUTPUT

As this small air-operated bench rammer dances rapidly over the foundry mold, tamping the sand firmly into place, it is really multiplying output. More work is produced with less effort and the uniform blows of the tamper produce a higher quality job.

There are several factors that make this possible...To begin with fatigue is reduced to a minimum because the lightweight rammer, not the man, does the work. The easy-holding qualities of this air tool, combined with positive throttle control, enable him to do the tamping quickly and get on with the rest of the operation.

In addition to multiplying your tamping output,* I-R Air Tools are available to help you do the same thing with many other operations such as – drilling, reaming, riveting, chipping, scaling, hoisting, digging, nut-running, etc. Whether the job is large or small, we have an Air Tool for it. Ask one of our Service Engineers to help you make a selection.

**The I-R line also includes floor rammers and backfill tampers.*

Ingersoll-Rand

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COMPRESSORS · CONDENSERS · TURBO BLOWERS · CENTRIFUGAL PUMPS · ROCK DRILLS · AIR TOOLS · OIL AND GAS ENGINES

Gargoyle D.T.E. Oil Heavy Medium helps you

SAVE TUGGER HOIST POWER & PARTS!

THIS CUTAWAY DRAWING shows you why your utility (tugger) hoist needs the very best lubrication protection you can buy . . . to stay on the job and deliver full power.

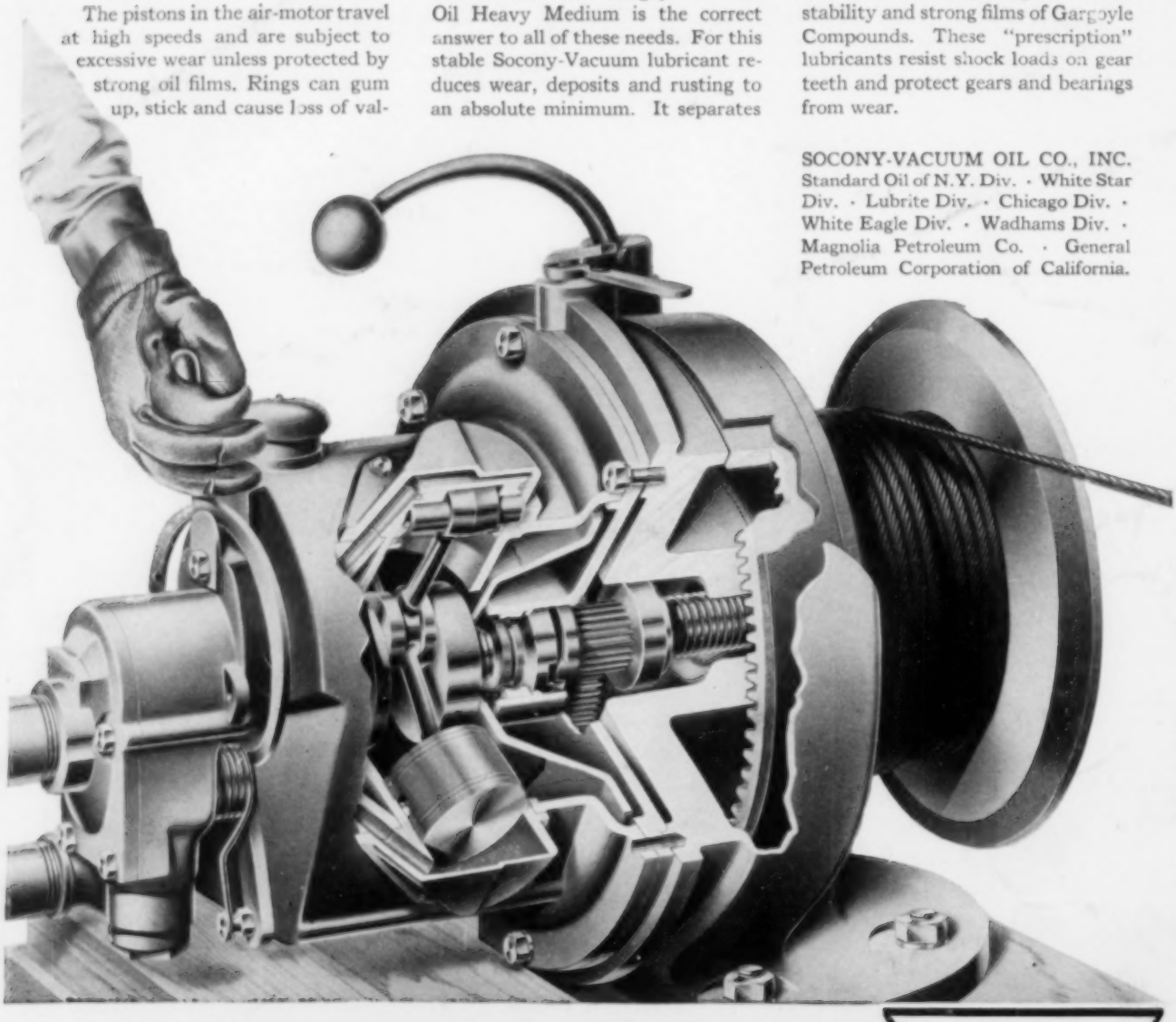
The pistons in the air-motor travel at high speeds and are subject to excessive wear unless protected by strong oil films. Rings can gum up, stick and cause loss of valuable power. Water is often present and the oil used must resist the formation of emulsions.

Hundreds of air hoist operators have found that Gargoyle D.T.E. Oil Heavy Medium is the correct answer to all of these needs. For this stable Socony-Vacuum lubricant reduces wear, deposits and rusting to an absolute minimum. It separates readily from water. Rings stay free. Power and maintenance time are saved.

★ ★ ★

For the gears and bearings in the gear end, you need the high chemical stability and strong films of Gargoyle Compounds. These "prescription" lubricants resist shock loads on gear teeth and protect gears and bearings from wear.

SOCONY-VACUUM OIL CO., INC.
Standard Oil of N.Y. Div. · White Star Div. · Lubrite Div. · Chicago Div. · White Eagle Div. · Wadhams Div. · Magnolia Petroleum Co. · General Petroleum Corporation of California.



SOCONY-VACUUM'S 5 Steps to Lower Production Costs:

1. Lubrication Study of Your Entire Plant
2. Lubrication Schedules and Controls
3. Lubricant Storage and Handling System
4. Skilled Engineering Counsel
5. Progress Reports of Benefits Secured

GARGOYLE Lubricants

TUNE IN "INFORMATION PLEASE"—MONDAY EVENINGS, 9:30 E.W.T.—NBC